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TOROS UNIVERSITY
JOURNAL OF FOOD, NUTRITION AND GASTRONOMY

Research Article / Araştırma Makalesi

Spirulina platensis'in Yoğurt ve Peynir Starter Kültürleri Üzerine Stimüle Etkisi

Stimulating Effect of Spirulina platensis on Yogurt and Cheese Starter Cultures

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Özet

Süt, düşük asitte ve yüksek su aktivitesine sahip bir gıda mamulü olup işlenip muhafaza edilmediği sürece hızla bozulmaktadır. Sütün işlenip raf ömrünü uzatmanın yollarından birisi de yoğurt ve peynir olarak üretimidir. Yoğurt ve peynirin endüstriyel üretiminde starter kültürlerden faydalanılmaktadır. Besin bileşimleri, fonksiyonel çeşitliliği ve esnek metabolizmaları nedeniyle mikroalgler, laktik asit bakterileri (LAB) ve mayaların üreme/gelişmesini ve metabolik faaliyetlerini destekleyerek fermantasyon süreçlerinin yüksek verimli gerçekleşmesini sağlamaktadır. Bir mikroalg türü olan *Spirulina platensis* son dönemlerde yaygın şekilde diyet takviyesi olarak kullanılmaktadır. Bunu sağlayan en önemli etmenin vitamin, mineral madde ve farklı besin ögelerini önemli ölçüde bulunduruyor olmasıdır. Bu çalışmada, farklı konsantrasyonlarda (2,5 mg/ml, 5 mg/ml, 7,5 mg/ml ve 10 mg/ml) hazırlanan *S. platensis* metanol ekstraktlarının, süt endüstrisinde çeşitli mamullerin üretiminde (beyaz peynir, yoğurt) starter kültür niteliği açısından ticari olarak kullanılan laktik asit bakterileri (*Lactococcus lactis* subsp. *cremoris*, *Lactococcus lactis* subsp. *lactis* ve *Streptococcus thermophilus*, *Lactobacillus delbrueckii* subsp. *bulgaricus*) üzerine stimüle etkisi araştırılmıştır. Araştırma sonucunda, *Spirulina platensis*'in çalışılan tüm konsantrasyonlarında ve çalışılan sürelerde çalışılan starter kültürler üzerinde logaritmik bir düzeyde bir değişim oluşturmadığı gözlenmiştir.

Abstract

Milk is a food product with low acidity and high-water activity and rapidly deteriorates unless processed and preserved. As one of the ways to obtain a stable product from milk is processing to yoghurt and cheese. For commercial purposes starter cultures are employed in production of yoghurt and cheese. Some microalgae types are used to support the activities of lactic acid bacteria in fermentation processes. *Spirulina platensis*, a type of microalgae, has recently been widely used as a dietary supplement. Containing elevated levels of vitamins, minerals and other nutritional components, *S. platensis* has a metabolic activity enhancing effect on humans. The current study investigated to determine stimulatory effect of methanolic extracts of *S. platensis* at different concentrations ranging from 2.5 mg/ml to 10 mg/ml on starter cultures (*Lactococcus lactis* subsp. *cremoris*, *Lactococcus lactis* subsp. *lactis*, and *Streptococcus thermophilus Lactobacillus delbrueckii* subsp. *bulgaricus*) of yoghurt and cheese. Findings of the study was outlined that *Spirulina platensis* affected no change on the growth of starter cultures studied at all concentrations of different time intervals.

EXTENDED SUMMARY

INTRODUCTION

Milk is a food product with low acidity and high-water activity, and as a result, decays rapidly unless precautionary steps are hired. As one of the ways to process milk and extending its shelf life is to produce fermented foods such as, yoghurt and cheese. Cheese production is made up by handling various techniques such as heating (pasteurization), culturing, direct acidification, dehydration, cooling and packaging. Yogurt is traditionally produced at industrial scale by using *Streptococcus thermophilus* and *Lactobacillus bulgaricus* starter cultures.

Spirulina platensis, a microalgae species, has recently been widely used as a dietary supplement (9). *S. platensis*, which contains high amounts of vitamins, minerals and other nutritional components in its structure, influences increasing metabolic activity in humans.

Spirulina spp. stands out in terms of nutrition, thanks to the 95% digestibility of the proteins in its structure. *Spirulina* where contain high numbers of essential amino acids (lysine, valine and isoleucine, effectively meets this specific need of consumers.

Spirulina spp. also has other biological functions such as antiviral, antibacterial, antifungal and antiparasitic activities (12). Microalga types provide supportive growth mechanisms to fermentative microorganisms. In a study of Parada et al. (1998) investigating the effects of *A. platensis* filtrate on the fermentation phase of Lacticacid bacteria species (LABs); They observed a stimulating effect on the growth of LABs (*Lactococcus lactis*, *Streptococcus thermophilus*, *Lactobacillus casei*, *Lactobacillus acidophilus* and *Lactobacillus bulgaricus*) cultivated on MRS (de Man–Rogosa–Sharpe agar) medium. And this result was recorded as the first data obtained on this subject in the literature (13).

In this study, the effect of *S. platensis* on promoting the growth of LABs was examined and for this purpose, different concentrations of methanol extracts of *S. platensis* (2.5 mg/ml, 5 mg/ml, 7.5 mg/ml and 10 mg/ml were used) stimulating effect on lactic acid bacteria (*Lactococcus lactis* subsp.. *cremoris*, *Lactococcus lactis* subsp.. *lactis*, *Streptococcus thermophilus* and *Lactobacillus delbrueckii* subsp.. *bulgaricus*) used as starter culture in the production of white cheese and yoghurt was studied.

MATERIAL AND METHOD

L. lactis subsp. *cremoris* and *L. lactis* subsp. *lactis* used together as starter cultures in cheese production were supplied by Chr. Hansen A/S (Denmark) with the product code Rst-743, and *L. delbrueckii* subsp. *bulgaricus* and *Str. thermophilus* used together as starter cultures in yoghurt production were supplied by Chr. Hansen A/S (Denmark) with the product code YOFLEX M790.

While, *S. platensis* was obtained in dried powder form from Çukurova University Fisheries Faculty.

First of all, in order to activate lactic acid bacteria, Tryptic Soy Broth was prepared and distributed into tubes and sterilized in an autoclave at 121°C for 15 minutes. Lyophilized starter cul-

tures (YOFLEX M790) were added to these tubes prepared under sterile conditions at a rate of 2%w/v. Incubation was performed for 48 hours at 42oC for *Str. thermophilus*, and for 48 hours at 30oC for *L. lactis* subsp *cremoris* +*L. lactis* subsp *lactis*. An anaerobic environment was provided by adding 1 ml of liquid paraffin onto the *L. delbrueckii* subsp *bulgaricus* suspension and was incubated for 48 hours at 42oC.

Methanol extracts of *S. platensis* at 4 different concentrations (2.5 mg/ml, 5 mg/ml, 7.5 mg/ml and 10 mg/ml) were prepared and used to investigate the stimulating effect on starter cultures. For this purpose, dried form of seven grams of *S. platensis* were weighed and dissolved in a 105 milliliters of 85% methanol (v/v). After five hours of agitation, the solution was sonicated for 15 mins. using an ultrasonic processor (UP200S, Hielscher, Germany). Upon sonication, a Whatman filter paper (Nr. 1) was used for filtration. Methanol was then evaporated using a bench type Rotary Evaporator (Heidolph, Type Rotavac valve tec, Germany). Obtained crude extract was stored at -20°C in sealed tubes for further use. The required concentrations (2.5 mg/ml, 5 mg/ml, 7.5 mg/ml and 10 mg/ml) from the stock crude extract were then dissolved in 75% methanol (v/w), were then stored at ambient temperature in darkened cabinet for subsequent use (Bhowmik et al., 2009). Agar diffusion method was applied in the study. Its effect on *Str. thermophilus* was studied by the spread plate method on plates containing M17 Agar. The seeded petri dishes were incubated under aerobic conditions at 37°C for 48 hours. The working procedure for *L. lactis* subsp. lactis+ *L. lactis* subsp. *cremoris* was the same as the work applied for *Str. thermophilus*, but for *L. delbrueckii* subsp. *bulgaricus*, MRS Agar medium was used differently, and it was studied under anaerobic incubation conditions at 45° C for 72 hours. Petri dishes without *S. platensis* extract were used as positive control. Cultivations were made in parallel. The study was performed at five replications.

RESULTS

The change in the growth of *Str. thermophilus* in the samples was observed at different concentrations (2.5 mg/ml, 5.0 mg/ml, 7.5 mg/ml and 10 mg/ml) and at three different time intervals (0 hours, 5 hours and 10 hours) were evaluated by comparing with control samples.

The highest growth of *Str. thermophilus* was observed after the 10th hour of incubation and with the addition of 10 mg/ml *S. platensis* extract. In case of the *L. lactis* subsp cremoris+ *L. lactis* subsp *lactis* mixed culture, the *S. platensis* concentration was observed to be 10 mg/ml, while the highest *L. lactis* subsp *cremoris* + *L. lactis* subsp *lactis* numbers were determined as 7.43 and 7.45 $\log_{10}$ cfu/ml at the fifth and tenth hours, respectively. Findings revealed that the effect of *S. platensis* on *L. delbrueckii* subsp. *bulgaricus* was positively judged, where the bacterial numbers reached to its highest value of 7.45 $\log_{10}$ cfu/ml at the tenth hour.

DISCUSSION AND CONCLUSION

In conclusion, a statistical increase was observed by beginning up to the 10th hour of starter cultures (*Str. thermophilus*, *L. delbrueckii* subsp. *bulgaricus* and *L. lactis* subsp *cremoris* + *L. lactis* subsp *lactis)* selected as test microorganisms with increasing proportions of all methanol extracts of *S. platensis* used. However, results of the study outlined that, the increases exceeded not a single logarithmic unit.

In a similar study, Çelekli et al. (2019) determined that adding *S. platensis* to buttermilk (Ayran) at different concentrations (0.25, 0.5, 1%) increased the numbers of *Str. thermophilus* both before and after fermentation (including storage for up to 21 days) compared to the control group (24). The researchers found that there was a statistically significant increase in *L. delbrueckii* subsp. *bulgaricus* only in the control group on the 21st storage day, but they determined that the increases recorded during the storage period at other concentrations (0.25, 0.5, 1%) did not differ significantly ($p>0.05$).

Many other studies (11, 19, 25, 26, 27), found a significant stimulating effect of *S. plantesis*. In the current study, the fact that there was no stimulating effect encountered where exceeded not a single logarithmic unit. This might be arisen from the type of algae used, its form and the way of the extracts are obtained.

Author Contribution

Design of the study, Analysis of data; IV

Obtaining study data, Creating the article draft; IV, BAO

Statistical analysis and drafting of the article; SU

Author involved in critical review of content and final approval of the manuscript; IV

Conflict of Interest

None to be declared

1. GİRİŞ

Süt, beslenme gereksinimlerini yerine getirmek için geleneksel olarak dünya genelinde tüketilen değerli bir gıda maddesidir. Birçok önemli besin ögeleri (protein, mineraller ve vitaminler) açısından değerli bir besin kaynağıdır (1).

Süt ve süt ürünlerinden farklı gıda ürünlerinin üretiminde yararlanılmaktadır. Süt, peynir, yoğurt, tereyağı, krema gibi birçok süt bazlı ürünün ana hammaddesidir. Bu ürünlerin çeşitliliği ve besin değeri, sütün endüstriyel kullanımını yaygınlaştırmıştır. Sütün raf ömrünü uzatmak ve farklı ürünlere dönüştürmek için insanlık tarihi boyunca çeşitli yöntemlerden yararlanılmıştır.

Sütte doğal olarak bulunan bakteri ve mayaların fermentasyonu ile de fermente süt ürünleri üretilebilmektedir (2, 3).

Bu süreç, sütte bulunan karbonhidratların (çoğunlukla laktoz) bakteri veya mayalar tarafından fermantasyonu ve sonucunda organik asitlerin, genellikle laktik asidin, oluşmasını içerir.

Açığa çıkan laktik asit pH değerini düşürerek sütün asitliğini arttırır. Asit oranı yükselen sütte zararlı mikroorganizmalar engellenmiş olurken, sütün dayanıklılığı artar ve bozulma süreci yavaşlar (4).

Laktik asit bakterilerinin metabolik faaliyetleri sonucunda organik asitlerin yanı sıra çeşitli aroma bileşenleri de açığa çıkar. Bu süreçte, bakterilerin fermantasyonu sırasında karbonhidratların fermantasyon ürünlerine dönüştürülmesiyle ortaya çıkan metabolik atıklar, elde edilen fermente ürünlere has duyusal nitelikler (tat, koku, aroma) ve tekstür kazandırmaktadır. Bunun yanı sıra, bir kısım laktik asit bakterilerinin vitamin (örneğin B vitamini) sentezinde etkinlik gösterdiği de bilinmektedir. Bu nedenle, fermantasyon süreci ve laktik asit bakterilerinin metabolik aktiviteleri, fermente süt ürünlerinin kalitesi ve takviye edici değeri üzerinde önemli bir etkiye sahiptir (4).

Peynir endüstrisinde yaygın olarak kullanılan peynir olgunlaşmasında hayati rol oynayan laktik asit bakterileri (LAB), genellikle *Lactococcus*, *Lactobacillus, Enterococcus, Streptococcus* ve *Leuconostoc* cinslerine aittir. Laktik asit bakterilerinin faaliyeti, peynirin raf ömrünü uzatmada önemli bir rol oynar. Bu nedenle, LAB'lerin mikrobiyal metabolizmasının ve etkilerinin peynir endüstrisinde ürün kalitesinin iyileştirilmesi ve tüketicilere daha sağlıklı ve lezzetli peynirler sunulması açısından önemlidir. Laktik asit bakterileri aynı zamanda probiyotik özelliklere sahip olmaları nedeniyle sindirim sistemindeki faydalı bakterilerin çoğalmasını destekler, zararlı bakterilerin etkisini azaltır ve böylece bağırsak mikrobiyotasının dengelenmesine katkıda bulunurlar (5).

Bir diğer fermente süt ürünü olan yoğurtta, *S. salivarius* subsp. *thermophilus*, *Lb. helveticus*, *Lb. delbrueckii* subsp. *lactis* ve *Lb. delbrueckii* subsp. *bulgaricus* bakterileri etkinlik göstermektedir. Bu bakteriler, yoğurt üretiminde sütün asitleştirilmesini sağlayarak ürünün kıvamını ve tat profilini belirlerler. Bu işlem, yoğurdun bozulmasını önleyerek saklama süresini artırır ve aynı zamanda ürüne özgü lezzet ve tekstürün oluşumunu sağlar (6).

Yoğurt, protein, kalsiyum, potasyum, fosfor, B2 vitamini ve B12 vitamini gibi çeşitli temel besin öğelerinin önemli bir kaynağıdır. Bu besin öğeleri, vücut için gerekli olan bir dizi biyolojik işlevi destekler ve özellikle kemik sağlığı, kas fonksiyonları ile metabolizma için kritik öneme sahiptir. Aynı zamanda, yoğurdun tüketimi ile barsak mikroflorasında denge durumu ile metabolik aktiviteler açısından farklılaşmalar meydana gelebilmektedir. Bu nedenle, düzenli olarak yoğurt tüketimi, genel sağlık ve sindirim sistemi için

önemli faydalar sağlamaktadır (1, 7).

Mikroalgler ise mikroskobik canlılar olup çapı 2 μm'den küçük, siyanobakteriler gibi prokaryot veya yeşil algler gibi ökaryotik olabilmektedir (8). Bir mikroalg türü olan *Spirulina platensis* son dönemlerde yaygın şekilde diyet takviyesi olarak kullanılabilmektedir (9).

Spirulina platensis siyanobakteriler içerisinde çok hücreye sahip ipliksi yapıda filamentli bir organizasyona sahiptir. Yüksek oranda (%95) sindirilebilir protein barındırması bu alglerin besin kaynağı olarak seçiminde önem teşkil etmektedir. Kuru maddede %6-7 aralığında lipid içeren *Spirulina* spp. linoleik asit, γ-linolenik asit gibi elzem yağ asitlerini barındırmaktadır. Bununla birlikte, çeşitli vitaminleri (örneğin A, B2, B3, B12) ve mineralleri (örneğin demir, magnezyum, kalsiyum, potasyum) bulundurmaktadır (10, 11).

Spirulina ayrıca pek çok mikrobiyal türe (bakteriler, virüsler, fungal hücreler, parazitler) karşı da antimikrobiyal aktivite gösterebilmektedir (12). Algler, özellikle *Spirulina* (*Arthrospira) platensis* besin bileşimleri, fonksiyonel çeşitliliği ve esnek metabolizmaları nedeniyle laktik asit bakterileri (LAB) ve mayalar için iyi bir fermantasyon substratı olarak görülmektedirler.

Parada ve ark. (1998) *Arthrospira platensis*'in LAB türlerinin fermantasyonları aşamasındaki etkilerinin ilk kez araştırıldığı çalışmalarında; MRS ve RM besiyerlerine ekilmiş olan LAB'ların (*Lactococcus lactis, Streptococcus thermophilus, Lactobacillus casei*, *Lactobacillus acidophilus* ve *Lactobacillus bulgaricus*) büyümesi üzerinde uyarıcı bir etki gözlemişlerdir (13).

Laktik asit bakterilerinin üremesini destekleyici olarak *A. platensis* ve *Chlorella vulgaris*'in potansiyeli test edilmiş ve alglerin bazı LAB ve probiyotik suşlarının (*Str. thermophilus, Lc. lactis* subsp. *lactis*, *Lb. delbrueckii* subsp. *bulgaricus*, *Lb. acidophilus, Bifidobacterium* spp., *Lb. plantarum, E. faecium* ve *Bifidobacterium animalis* subsp. *lactis*) büyümesini ve hayatta kalmasını artırdığı yürütülen başka araştırmalar ile de doğrulanmıştır (14, 15, 16, 17).

Chlorella vulgaris, Arthrospira platensis, Haematococcus pluvialis ve *Dunaliella salina* gibi bazı mikroalgler esas olarak gıda, yem ve nutrasötik sektörlerinde pazarlanmaktadır. Bu alglerin protein, karotenoidler, omega-6 ve omega-3 lipitleri üretme potansiyellerine dayanarak, hayvan yemi ve su ürünleri yetiştiriciliği, protein ve kozmetik gibi birçok pazarda geniş uygulama alanları bulunmaktadır (18).

Spirulina spp. protein sindirilebilirlik oranı yüksek (%95) olmakla beraber lisin, valin ve izolisin gibi esansiyel amino asitler açısından zengindir. Bu esansiyel amino asitler, insan vücudu tarafından sentezlenemediği için dışarıdan alınmaları gereklidir ve *Spirulina* bu ihtiyacı etkili bir şekilde karşılamaktadır (10, 11).

Bu çalışmada, LAB'lerin üreme, gelişmesini teşvik edici *S. platensis* farklı konsantrasyonlara sahip (2,5 mg/ml, 5 mg/ml, 7,5 mg/ml ve 10 mg/ml) metanolik ekstraktların, beyaz peynir ve yoğurt üretiminde starter kültür olarak kullanılan laktik asit bakterileri (*Lactococcus lactis* subsp.. *cremoris*, *Lactococcus lactis* subsp.. *lactis*, *Streptococcus thermophilus* ve *Lactobacillus delbrueckii* subsp.. *bulgaricus*) üzerine stimüle etkisinin araştırılması amaçlanmıştır.

2. MATERYAL VE METOT

2.1. Materyal

2.1.1. Starter Kültür Olarak Kullanılan Laktik Asit Bakterileri

Peynir üretiminde starter kültür olarak birlikte kullanılan *Lactococcus lactis* subsp. *cremoris* ile *Lactococcus lactis* subsp. *lactis* Chr. Hansen A/S (Danimarka) firmasından RST-743 ürün kodu ile yoğurt üretiminde starter kültür olarak birlikte kullanılan *Lactobacillus delbrueckii* subsp. *bulgaricus* ile *Streptococcus thermophilus* da yine Chr. Hansen A/S (Danimarka) firmasından YOFLEX M790 ürün kodu ile temin edilmiştir.

2.1.2. *Spirulina platensis*

Spirulina platensis mikroalglerinin temini Çukurova Üniversitesi Su Ürünleri Fakültesi'nden toz şeklinde sağlanmıştır.

2.2. Yöntem

2.2.1. Çalışmada kullanılan Laktik Asit Bakterilerinin Aktive Edilmesi

Öncelikle laktik asit bakterilerinin aktive edilmesi amacı ile Tryptic Soy Broth kullanılmış ve steril edilmiş Tryptic Soy Broth (TSB) tüpleri içerisine liyofilize starter kültürler Rst-743 %1, (w/v) ve YOFLEX M790 %2, (w/v) oranında aseptik koşullar altında ilave edilmiştir. *Streptococcus thermophilus* için 48 saat 42ºC'de inkübasyon işlemi, *Lactococcus lactis* subsp. *cremoris*, *Lactococcus lactis* subsp. *lactis* için 30ºC'de 48 saat inkübasyon işlemi uygulanmıştır. *Lactobacillus delbrueckii* subsp. *bulgaricus* süspansiyonu üzerine 1 ml sıvı parafin ilave edilip (anaerobik ortamı sağlamak için) 48 saat 42ºC'de inkübasyona bırakılmıştır (19, 20).

2.2.2. *Spirulina platensis*'in Metanolik Ekstraktlarının Hazırlanması

Kuru olarak temin edilen *Spirulina platensis* 7 g tartılmış, üzerine 105 ml çözücü olarak metanol (%85 v/v) ilave edilerek, oda sıcaklığında 5 saat bekletildikten sonra 15 dakika sonikasyon (UP200S, hielscher, Germany) uygulanmıştır. Sonikasyondan sonra Whatman filtre kağıdından (Nr.1) süzülmüştür. Elde edilen ekstraktdaki metanol Rotary Evaporator cihazı (Heidolph, Type Rotavac valve tec, Germany) kullanılarak evapore edilip uzaklaştırılmıştır. Elde edilen kalıntı (ham ekstrakt) daha sonra analizlerde kullanılıncaya kadar hava geçirmez şişelerde -20 °C'de saklanmıştır. Daha sonra elde edilen ekstraktlar dört farklı konsantrasyonda (2,5 mg/ml, 5 mg/ml, 7,5 mg/ml ve 10 mg/ml) 75% metanol (v/w) içinde hazırlanmıştır. (21, 22, 23).

2.2.3. Mikrobiyolojik Analizler

TSB (Tryptic Soy Broth) kullanarak aktive edilmiş laktik asit bakteri tüplerinden birer mililitre alınarak, %0,1 peptonlu su içerisinde seri dilüsyonlar (10-8) hazırlanarak vortekslenmiştir (19, 20).

Çalışmada *Spirulina platensis'in* laktik asit bakterisi kültürlerine etkisini çalışmak için agar difüzyon yöntemi uygulanmıştır. *Streptococcus thermophilus*'un etkisini belirlemek amacıyla, dilüsyonlardan 0,1 ml'lik süspansiyonlar iki paralelli M17 Agar besiyerine cam drigalski spatülü yardımıyla homojen bir şekilde dağıtılmıştır (yayma plak yöntemi) (24).

Petri kutuları 37°C'de 48 saat aerobik inkübasyona bırakılmıştır. *Lactococcus lactis* subsp.. *lactis* + *Lactococcus lactis* subsp.. *cremoris* ve *Str. thermophilus* için uygulanan metodoloji aynı olup, *Lactobacillus delbrueckii* subsp. *bulgaricus* için MRS Agar besiyerine ekim yapılmış, 45°C'de 72 saat anaerobik inkübasyon uygulanmıştır. *S. platensis* metanol ekstraktı ilave edilmeyen petriler pozitif kontrol olarak kullanılmıştır. Çalışma 2 paralelli, 5 tekerrür olarak uygulanmıştır (24, 25).

3. BULGULAR

3.1. *Spirulina platensis'in Streptococcus thermophilus* üzerine etkisi

Spirulina platensis'in 2,5 mg/ml, 5,0 mg/ml, 7,5 mg/ml ve 10 mg/ml konsantrasyonlarında 3 farklı zamanda (0 saat, 5 saat ve 10 saat) *Streptococcus thermophilus*'un üremesi üzerindeki etkisi kont-

Çizelge 1. *Spirulina platensis*'in *Streptococcus thermophilus* üzerine etkisi

S. platensis konsantrasyon (mg/ml)	0. saat	5. saat	10. saat
0	7,30 ± 0,00 ^{aA}	7,33 ± 0,00 ^{aB}	7,35 ± 0,00 ^{aC}
2,5	7,31 ± 0,00 ^{bA}	7,36 ± 0,00 ^{bB}	7,38 ± 0,00 ^{bC}
5	7,31 ± 0,00 ^{bcA}	7,37 ± 0,00 ^{cB}	7,41 ± 0,00 ^{cC}
7,5	7,31 ± 0,01 ^{cA}	7,40 ± 0,00 ^{dB}	7,42 ± 0,00 ^{dC}
10	7,30 ± 0,00 ^{aA}	7,33 ± 0,00 ^{aB}	7,35 ± 0,00 ^{aC}

Aynı sütundaki farklı harfler (a, b, c, d) veriler arasında istatistiksel açıdan anlamlı derecede farklılık olduğunu göstermektedir (P<0.05). Aynı satırdaki farklı harfler (A, B, C) veriler arasında istatistiksel açıdan anlamlı derecede farklılık olduğunu göstermektedir (P<0.05).

rol örnekleriyle değerlendirilerek Çizelge 1'de verilmiştir.

Pozitif kontrol (0 mg/ml) örneklerinde *Streptococcus thermophilus* değeri ilk analiz saatinde 7,30 $\log_{10}$ kob/ml olarak gözlenmiştir. Beşinci saatte 7,33 $\log_{10}$ kob/ml seviyesine geldiği tespit edilmiştir. Onuncu saat analizinde *Str. thermophilus* sayısı 7,35 $\log_{10}$ kob/ml düzeyinde bulunmuştur. Bu değişimlerin istatistiksel açıdan farklılık gösterdiği belirlenmiştir ($p<0,05$) (Çizelge 1).

2,5 mg/ml konsantrasyonda *S. platensis* örneklerinde ilk analiz saatinde 7,31 $\log_{10}$ kob/ml düzeyinde olduğu belirlenen *Str. thermophilus'* un, beşinci saat analizinde 7,36 $\log_{10}$ kob/ml olarak tespit edilmiştir. Onuncu saat analizinde *Str. thermophilus* sayısı 7,38 $\log_{10}$ kob/ml düzeyinde bulunmuştur. Bu değişimlerin istatistiksel açıdan farklılık gösterdiği belirlenmiştir ($p<0,05$) (Çizelge 1).

5 mg/ml konsantrasyonda *S. platensis* örneklerinin ilk analiz saatinde 7,31 $\log_{10}$ kob/ml düzeyinde olduğu belirlenen *Str. thermophilus'* un, beşinci saat analizinde 7,37 $\log_{10}$ kob/ml seviyesinde tespit edilmiştir. Onuncu saat analizinde *Str. thermophilus* sayısı en yüksek değerini alarak 7,41 $\log_{10}$ kob/ml düzeyine ulaşmıştır. Bu değişimlerin istatistiksel açıdan farklılık gösterdiği belirlenmiştir ($p<0,05$) (Çizelge 1).

7,5 mg/ml *S. platensis* konsantrasyon örneklerinde ise, ilk analiz saatinde 7,31 $\log_{10}$ kob/ml olan verinin, beşinci saat analizinde 7,40 $\log_{10}$ kob/ml seviyesine geldiği tespit edilmiştir. Onuncu saat analizinde *Str. thermophilus* sayısı en yüksek değerini alarak 7,42 $\log_{10}$ kob/ml düzeyine ulaşmıştır. Bu değişimlerin istatistiksel açıdan farklılık gösterdiği belirlenmiştir ($p<0,05$) (Çizelge 1).

10 mg/ml *S. platensis* konsantrasyon örneklerinin ilk analiz saatinde 7,30 $\log_{10}$ kob/ml olan sayımların beşinci saat analizinde 7,33 $\log_{10}$ kob/ml olarak tespit edilmiştir. Onuncu saat de ise *Str. thermophilus* sayısı 7,35 $\log_{10}$ kob/ml düzeyinde bulunmuştur. Bu artışların istatistiksel açıdan farklılık gösterdiği belirlenmiştir ($p<0,05$) (Çizelge 1).

Sıfırıncı saatin farklı konsantrasyonlara bağlı değişimler istatistiksel açıdan incelendiğinde, 0 mg/ml ile 10 mg/ml konsantrasyon aynı grupta yer almıştır; 5 mg/ml ise hem 2,5 mg/ml hem de 7,5 mg/ml ile aynı grupta bulunmuştur. Beşinci ve onuncu saatlerde farklı konsantrasyonlar arasındaki değişim istatistiksel açıdan değerlendirildiğinde, sıfırıncı saate benzer şekilde 0 mg/ml ile 10 mg/ml konsantrasyonları aynı grupta yer almıştır. 2,5 mg/ml, 5 mg/ml ve 7,5 mg/ml arasında ise farklılık bulunmuştur ($p<0,05$) (Çizelge 1).

3.2. *Spirulina platensis*'in *Lactococcus lactis* subsp. *cremoris* ve *Lactococcus lactis* subsp. *lactis* üzerine stimüle etkisi

Lactococcus lactis subsp. *cremoris* ile *Lactococcus lactis* subsp. *lactis*'in üremesindeki değişim Çizelge 2'de verilmiştir. *Spirulina platensis*'in farklı konsantrasyonlardaki (2,5 mg/ml, 5,0 mg/ml, 7,5 mg/ml ve 10 mg/ml) etkisi 3 farklı zamanda (0 saat, 5 saat ve 10 saat) kontrol örnekleriyle kıyaslanarak değerlendirilmiştir.

Buna göre, pozitif kontrol (0 mg/ml) örneklerinde *Lc. lactis* subsp. c*remoris ile Lc. lactis* subsp. *la-*

Çizelge 2. *Spirulina platensis*'in *Lactococcus lactis* subsp. *cremoris* + *Lactococcus lactis* subsp. *lactis* üzerine etkisi

S. platensis konsantrasyon (mg/ml)	0. saat	5. saat	10. saat
0	7,30 ± 0,00 ^{Aa}	7,33 ± 0,00 ^{aB}	7,35 ± 0,00 ^{aC}
2,5	7,31 ± 0,00 ^{cA}	7,36 ± 0,00 ^{bB}	7,38 ± 0,00 ^{bC}
5	7,31 ± 0,00 ^{cdA}	7,38 ± 0,00 ^{cB}	7,41 ± 0,00 ^{cC}
7,5	7,32 ± 0,00 ^{dA}	7,40 ± 0,00 ^{dB}	7,43 ± 0,00 ^{dC}
10	7,31 ± 0,00 ^{bA}	7,43 ± 0,00 ^{e}**B**	7,45 ± 0,00 ^{e}**C**

Aynı sütundaki farklı harfler (a, b, c, d) veriler arasında istatistiksel açıdan anlamlı derecede farklılık olduğunu göstermektedir ($P<0,05$). Aynı satırdaki farklı harfler (A, B, C) veriler arasında istatistiksel açıdan anlamlı derecede farklılık olduğunu göstermektedir($P<0,05$).

ctis değeri ilk analiz saatinde 7,30 $\log_{10}$ kob/ml olarak gözlenmiştir. Beşinci saat analizinde bu değerin 7,33 $\log_{10}$ kob/ml seviyesine geldiği tespit edilmiştir. Onuncu saat analizinde *Lc. lactis* subsp. *cremoris* ile *Lc. lactis* subsp. *lactis* sayısı 7,35 $\log_{10}$ kob/ml düzeyine ulaşmıştır. Bu değişimlerin istatistiksel açıdan farklılık gösterdiği belirlenmiştir ($p<0,05$) (Çizelge 2).

2,5 mg/ml konsantrasyonda *S. platensis* örneklerinde ilk analiz saatinde 7,31 $\log_{10}$ kob/ml düzeyinde olduğu belirlenen *Lc. lactis* subsp. *cremoris* ile *Lc. lactis* subsp. *lactis'* in, beşinci saat analizinde 7,36 $\log_{10}$ kob/ml seviyesinde tespit edilmiştir. Onuncu saat analizinde *Lc. lactis* subsp. *cremoris* ile *Lc. lactis* subsp. *lactis* sayısı 7,38 $\log_{10}$ kob/ml olarak bulunmuştur. Bu değişimlerin istatistiksel açıdan farklılık gösterdiği belirlenmiştir ($p<0,05$) (Çizelge 2).

5 mg/ml konsantrasyonda *S. platensis* örneklerinin ilk analiz saatinde 7,31 $\log_{10}$ kob/ml düzeyinde olduğunu belirlenen *Lc. lactis* subsp. *cremoris* ile *Lc. lactis* subsp. *lactis'* in, beşinci saat analizinde 7,38 $\log_{10}$ kob/ml seviyesinde bulunmuştur. Onuncu saat analizinde *Lc. lactis* subsp. *cremoris* ile *Lc. lactis* subsp. *lactis* sayısı 7,41 $\log_{10}$ kob/ml düzeyine ulaşmıştır. Bu değişimlerin istatistiksel açıdan farklılık gösterdiği belirlenmiştir ($p<0,05$) (Çizelge 2).

7,5 mg/ml konsantrasyonda *S. platensis* örneklerinde ilk analiz saatinde 7,32 $\log_{10}$ kob/ml düzeyinde olduğunu belirlenen *Lc. lactis* subsp. *cremoris* ile *Lc. lactis* subsp. *lactis'* un, beşinci saat analizinde 7,40 $\log_{10}$ kob/ml seviyesine geldiği tespit edilmiştir. Onuncu saat analizinde *Lc. lactis* subsp. *cremoris* ile *Lc. lactis* subsp. *lactis* sayısı 7,43 $\log_{10}$ kob/ml olarak bulunmuştur. Bu değişimlerin istatistiksel açıdan farklılık gösterdiği belirlenmiştir ($p<0,05$) (Çizelge 2).

10 mg/ml konsantrasyonda *S. platensis* örneklerinde ilk analiz saatinde 7,31 $\log_{10}$ kob/ml düzeyinde olduğunu belirlenen *Lc. lactis* subsp. cremoris ile *Lc. lactis* subsp. *lactis'* in, beşinci saat analizinde 7,43 $\log_{10}$ kob/ml seviyesinde tespit edilmiştir. Onuncu saat analizinde *Lc. lactis* subsp. *cremoris* ile *Lc. lactis* subsp. *lactis* sayısı 7,45 $\log_{10}$ kob/ml olarak belirlenmiştir. Bu değişimlerin istatistiksel açıdan farklılık gösterdiği bulunmuştur ($p<0,05$) (Çizelge 2).

Sıfırıncı saatin farklı konsantrasyonlardaki değişimleri istatistiksel açıdan incelendiğinde, 2,5 mg/ml ile 5 mg/ml konsantrasyonları aynı grupta yer almıştır. Diğer konsantrasyonlar (0 mg/ml, 7,5 mg/ml, 10 mg/ml) hem kendi aralarında hem de 2,5 mg/ml ve 5 mg/ml konsantrasyonlarıyla istatistiksel olarak farklılık ($p<0,05$) göstermiştir. Beşinci ve onuncu saatlerde ise, farklı konsantrasyonlar arasındaki değişim istatistiksel açıdan farklılık göstermiştir ($p<0,05$) (Çizelge 2).

3.3. *Spirulina platensis*'in *Lactobacillus delbrueckii* subsp.. *bulgaricus* üzerine etkisi

Lactobacillus delbrueckii subsp.. *bulgaricus* üremesindeki değişim Çizelge 3'te verilmiştir. *Spirulina platensis*'in farklı konsantrasyonlardaki (2,5 mg/ml, 5,0 mg/ml, 7,5 mg/ml ve 10 mg/ml) etkisi 3 farklı zamanda (0 saat, 5 saat ve 10 saat) kontrol örnekleriyle kıyaslanarak değerlendirilmiştir.

Pozitif kontrol grubunda (0 mg/ml) *Lactobacillus delbrueckii* subsp.. *bulgaricus* sayısı, ilk analiz saatinde 7,18 $\log_{10}$ kob/ml olarak gözlemlenmiş, beşinci saat analizinde 7,20 $\log_{10}$ kob/ml, onuncu saat analizinde ise 7,26 $\log_{10}$ kob/ml olarak bu-

Çizelge 3. *Spirulina platensis*'in *Lactobacillus delbrueckii* subsp.. *bulgaricus* üzerine etkisi

S. platensis konsantrasyon (mg/ml)	0. saat	5. saat	10. saat
0	7,18 ± 0,00 ^{aA}	7,20 ± 0,00 ^{aB}	7,26 ± 0,00 ^{aC}
2,5	7,19 ± 0,00 ^{aA}	7,21 ±0,00 ^{aB}	7,29 ± 0,00 ^{bC}
5	7,21 ± 0,00 ^{bA}	7,26 ±0,00 ^{bB}	7,35 ± 0,00 ^{cC}
7,5	7,22 ± 0,00 ^{bcA}	7,31 ±0,00 ^{cB}	7,39 ± 0,00 ^{dC}
10	7,23 ± 0,00 ^{cA}	7,36 ±0,00 ^{dB}	7,45 ± 0,00 ^{e}**C**

Aynı sütundaki farklı harfler (a,b,c,d) veriler arasında istatistiksel açıdan anlamlı derecede farklılık olduğunu göstermektedir ($P<0.05$).
Aynı satırdaki farklı harfler (A, B, C) veriler arasında istatistiksel açıdan anlamlı derecede farklılık olduğunu göstermektedir ($P<0.05$).

lunmuştur. Bu değişimlerin istatistiksel açıdan farklılık gösterdiği belirlenmiştir ($p<0,05$) (Çizelge 3).

2,5 mg/ml *S. platensis* konsantrasyonunda, *Lactobacillus delbrueckii* subsp.. *bulgaricus'*un sayısı ilk analiz saatinde 7,19 $\log_{10}$ kob/ml olarak belirlenmiş, beşinci saat analizinde 7,21 $\log_{10}$ kob/ml, onuncu saat analizinde ise 7,29 $\log_{10}$ kob/ml olarak tespit edilmiştir. Bu değişimlerin istatistiksel açıdan farklılık gösterdiği belirlenmiştir ($p<0,05$) (Çizelge 3).

5 mg/ml *S. platensis* konsantrasyonunda ise *Lactobacillus delbrueckii* subsp.. *bulgaricus'*un sayısı ilk analiz saatinde 7,21 $\log_{10}$ kob/ml olarak gözlemlenmiş, beşinci saat analizinde 7,26 $\log_{10}$ kob/ml, onuncu saat analizinde ise 7,35 $\log_{10}$ kob/ml olarak bulunmuştur. Bu değişimlerin istatistiksel açıdan farklılık gösterdiği belirlenmiştir ($p<0,05$) (Çizelge 3).

7,5 mg/ml *S. platensis* konsantrasyonunda ise *Lactobacillus delbrueckii* subsp.. *bulgaricus'*un sayısı ilk analiz saatinde 7,22 $\log_{10}$ kob/ml olarak gözlemlenmiş, beşinci saat analizinde 7,31 $\log_{10}$ kob/ml, onuncu saat analizinde 7,39 $\log_{10}$ kob/ml değerleri tespit edilmiştir. Bu değişimlerin istatistiksel açıdan farklılık gösterdiği belirlenmiştir ($p<0,05$) (Çizelge 3).

10 mg/ml *S. platensis* konsantrasyonunda *Lactobacillus delbrueckii* subsp.. *bulgaricus'*un sayısı ilk analiz saatinde 7,23 $\log_{10}$ kob/ml olarak gözlemlenmiş, beşinci saat analizinde 7,36 $\log_{10}$ kob/ml'ye, onuncu saat analizinde ise en yüksek değeri olan 7,45 $\log_{10}$ kob/ml'ye ulaşmıştır. Bu değişimlerin istatistiksel açıdan farklılık gösterdiği belirlenmiştir ($p<0,05$) (Çizelge 3).

Sıfırıncı saatin farklı konsantrasyonlardaki değişimleri istatistiksel açıdan incelendiğinde, 0 mg/ml 2,5 mg/ml ile; 5 mg/ml ise 7,5 mg/ml ile istatistiksel açıdan aynı grupta yer almıştır. 10 mg/ml konsantrasyonu ise, bu gruplardan istatistiksel olarak farklılık göstermiştir ($p<0,05$). Beşinci saat analizinde ise 0 mg/ml ile 2,5 mg/ml aynı grupta yer almıştır. Diğer konsantrasyonlar (5 mg/ml, 7,5 mg/ml, 10 mg/ml) ise hem kendi aralarında hem de bu grupla karşılaştırıldığında istatistiksel olarak farklılık göstermiştir ($p<0,05$). Onuncu saatte ise, farklı konsantrasyonlar arasındaki değişim istatistiksel olarak farklılık göstermiştir ($p<0,05$) (Çizelge 3).

Tüm bu sonuçlar değerlendirildiğinde her ne kadar istatistiksel olarak bir değişim olduğu görülse de, kontrol örnekleriyle *Spirulina platensis*'in çalışılan tüm konsantrasyonlarında ve sürelerinde mikroorganizma üremesinde logaritmik düzeyde bir değişim gözlenmemiştir.

4. TARTIŞMA VE SONUÇ

Yapılan çalışmamıza benzer olarak, Bhowmik ve ark. (2009) tarafından yapılan *Spirulina platensis*'in farklı konsantrasyonlarda (1, 5, 10 mg/ml) on saate kadarki zaman diliminde laktik asit bakterilerinin (*Streptococcus thermophilus*, *Lactobacillus acidophilus*, *Lactobacillus casei*) üremelerine stimüle edici etkisinin çalışıldığı araştırmada; *Streptococcus thermophilus*'un beşinci saatte kontrol grubuna göre %27, onuncu saatte ise %45 oranında üremesinin stimüle edildiği bildirilmiştir. Laktik asit bakterileri arasında *Streptococcus thermophilus*'un 10 mg/ml *S. platensis* eklendiği koşulda diğer laktik asit bakterileri arasında en düşük üreme değerine sahip olduğu belirlenmiştir. *Spirulina* biyokütlesinin asit gelişimini de destekleyici bir unsura sahip olduğu, bu sayede düşük pH'ya ulaşan ortamda laktik asit bakterilerinin üremesinin desteklendiği bildirilmiştir (25).

Bizim bulgularımızda ise *S. platensis*'in stimüle edici etkisinin bulunmamasının sebebinin, farklı üretici firmalardan temin edilen farklı suşların gösterdiği etkilerden kaynaklandığı düşünülmektedir.

Bir başka çalışmada, Çelekli ve ark. (2019), *S. platensis*'in farklı konsantrasyonlarda (0,25, 0,5, 1%) ayrana ilave edilmesinin hem fermentasyon öncesinde hem de fermentasyon sonrasında (21 güne kadarki depolanma da dahil) *Streptococcus thermophilus* sayısını kontrol grubuna kıyasla önemli derecede artırdıkları bildirilmiştir ($p<0,05$). Araştırmacılar, *Lactobacillus delbrueckii* subsp.. *bulgaricus* açısından sadece kontrol grubunun 21. depolama gününde istatistiksel olarak önemli derecede bir artış olduğunu tespit etmişlerdir; diğer konsantrasyonlarda (0,25, 0,5, 1%) depolama sürecinde kaydedilen artışların önemli derecede farklılık göstermediğini belirt-

mişlerdir (p>0,05). Araştırmacılar, bu artışların *S. platensis*'in yüksek oranda protein içermesi, pepton, serbest amino asitler, hipoksantin ve adenin bulundurmasından kaynaklandığını bildirmişlerdir (24).

Aydemir (2019)'da farklı oranlarda (%0,25; %0,50; %0,75 ve %1) *Spirulina platensis*'in yoğurtlarda streptokok ve laktobasil starter kültürleri üzerinde stimüle edici etkiler gösterdiğini belirlemiştir (26).

Guldas ve Irkin (2010) *Streptococcus thermophilus, Lactobacillus acidophilus* ve *Lactobacillus delbrueckii* subsp.. *bulgaricus*'un % 0,5 ve %1 oranlarında *Spirulina platensis* tozu ilave edilmiş yoğurdun 30 günlük depolanma sürecindeki etkilerini araştırmışlardır. Çalışılan yoğurt örneklerinde starter kültürlerin depolama sürecinde artış kaydettiği, *Str. thermophilus*'un *Lb. bulgaricus*'tan daha yüksek olduğu ve *Lb. acidophilus*'un ise her iki starter kültürden daha yüksek artışlar kaydettiği belirtilmiştir (27).

Akça (2020), yoğurt üretiminde *Streptococcus thermophilus, Lactobacillus bulgaricus, Bifidobacterium animalis* ve *Lactobacillus acidophilus* ile birlikte toz formda % 0,50, % 0,75 ve %1 *Spirulina platensis* kullanmıştır. %1 *S. platensis* katılmış yoğurt örneklerinde, *Lactobacillus bulgaricus* ve *Streptococcus thermophilus*'un 28'er günlük depolama sonucunda, başlangıç ve kontrol grubuna göre önemli derecede artış gösterdikleri belirtilmiştir. Sonuç olarak, *Spirulina* tozunun yoğurt üretiminde kullanılmasının starter ve probiyotik kültürler üzerine stimüle edici etkisinin bulunduğu belirtilmiştir (11).

Fadaei ve ark. (2013) feta peynirinde *Spirulina platensis*'in Lactococcus suşlarını (*Lactococcus lactis* subsp.. *lactis, Lactococcus lactis* subsp.. *cremoris*) stimüle edici etkisini belirlemeye yönelik yaptıkları bir araştırmada, bakteri kültürlerinin farklı konsantrasyonlardaki (%0,3, %0,5, %0,8) *Spirulina* ile 45 günlük depolama süresince üremelerinin desteklendiğini belirlemişlerdir.

Çelekli ve ark. (2019), depolama sürecinde *Lactobacillus delbrueckii* subsp.. *bulgaricus* açısından sadece kontrol grubunun 21. depolama gününde istatistiksel olarak önemli derecede artış gösterdiğini tespit etmişlerdir; ancak diğer konsantrasyonlarda (%0,25, 0,5, 1) depolama sürecinde kaydedilen artışların önemli derecede farklılık göstermediğini belirlemişlerdir (p>0,05). Buna rağmen *Spirulina platensis*'in probiyotik bakterilerin üreme/gelişmesini destekleyeceği ve ayranın besin kalitesini arttıracağına ilişkin değerlendirmede bulunmuştur (24).

Bu çalışmadan elde edilen bulgular ışığında, *S. platensis* metanol ekstraktlarının çalışılan tüm konsantrasyonlarında test edilen yoğurt ve peynir starter kültürleri (*Streptococcus thermophilus*, *Lactobacillus delbrueckii* subsp.. *bulgaricus* ve *Lactococcus lactis* subsp. *cremoris* ile *Lactococcus lactis* subsp. *lactis*) üzerinde logaritmik düzeyde bir stimülasyon etkisinin olmadığı görülmüştür.

Buna neden olarak da kullanılan algin çeşidi, formu ve ekstraktların elde ediliş biçimlerinin stimülasyon etkisinin değerlendirilmesinde farklı sonuçlarla karşılaşılabileceğini düşündürtmüştür. Bu nedenle araştırmanın tüm bu parametreler ışığında yeniden gözden geçirilerek kurgulanması ve çalışmanın hem *in vitro* hem de *in situ* olarak yapılmasının, stimülasyon etkisini değerlendirmede daha gerçekçi veriler elde edilmesi için gerek olduğuna düşünülmektedir.

5. Yazar Katkısı

Çalışmanın tasarımı, Verilerin analizi; IV

Çalışma verilerinin elde edilmesi, Makale taslağının oluşturulması; IV, BAO

İstatistiksel analiz ve Makale taslağının oluşturulması; SU

İçerik için eleştirisel gözden geçirme ve makalenin son onayında görev alan yazar; IV

6. Teşekkür

Bu çalışmada kullanılan *Spirulina platensis*'i üreterek çalışmamızda kullanılmasını sağlayan Çukurova Üniversitesi Su Ürünleri Fakültesi öğretim üyeleri sayın Prof. Dr Oya IŞIK ve Prof. Dr. Leyla USLU'ya minnetlerimizi ifade ederken, aynı zamanda Çukurova Üniversitesi BAP birimine FYL-2023-15713 kodlu proje desteğinden dolayı da teşekkür ederiz.

7. Çıkar Çatışması

Çıkar çatışması yoktur.

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Research Article / Araştırma Makalesi

The effect of respiratory problems and nutritional characteristics of children on sleep quality and influencing factors: A descriptive study

Çocukların solunum problemlerinin ve beslenme özelliklerinin uyku kalitesi üzerindeki etkisi ve etkileyen faktörler: Tanımlayıcı bir çalışma

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Abstract

The aim of this study was to determine the effect of respiratory problems and nutritional characteristics on sleep quality in children and the factors related to this effect. This descriptive and cross-sectional study was conducted in a hospital between October 2023 and July 2024. Data were collected using child information form and Pediatric Sleep Questionnaire: Sleep-disordered breathing subscale. Data were analyzed by computer with 95% confidence interval. A total of 101 children with an average age of 7.3±3.7 years and their mothers participated in the study. The mean sleep quality scale score was 0.22 points. Scale score and number of snacks (p=0.033) and time (p=0.046), daytime sleep status (0.000) and duration of sleep (p=0.000), nighttime awakenings (p=0.023) and number of awakenings (p=0.030), Feature of the room where he sleeps (p=0, 006), presence of health problems (p=0.004), respiratory disorders (p=0.000) and presence of attention-deficit-hyperactivity-disorder and sleep disturbance

diagnosed by polysomnography (p=0.000). The health of their mothers was also found to be an important factor. In order for children to have a healthy growth and development period, their sleep needs should be met in a healthy way. It is important to ensure sleep and nutritional regularity for sleep quality. It was observed that individual and family-based interventions are necessary for a healthy sleep pattern.

Özet

Solunum ve beslenme sorunları çocuklarda uyku kalitesini etkileyen faktörlerden biridir. Bu çalışmanın amacı, çocuklarda solunum problemleri ve beslenme özelliklerinin uyku kalitesi üzerine etkisini ve bu etkiyle ilişkili faktörleri belirlemektir. Tanımlayıcı ve kesitsel tipteki bu çalışma Ekim 2023-Temmuz 2024 tarihleri arasında bir hastanede yürütülmüştür. Veriler çocuk bilgi formu ve Pediatrik Uyku Anketi: Uykuda solunum bozuklukları alt ölçeği kullanılarak toplanmıştır. Veriler bilgisayar ortamında %95 güven aralığında analiz edilmiştir. Çalışmaya yaş ortalaması 7,3±3,7 yıl olan toplam 101 çocuk ve anneleri katılmıştır. Ortalama uyku kalitesi ölçeği puanı 0,22 idi. Ölçek puanı ile ara öğün sayısı (p=0,033) ve zamanı (p=0,046), gündüz uyuma durumu (0,000) ve uyuma süresi (p=0,000), gece uyanma durumu (p=0,023) ve uyanma sayısı (p=0,030), uyku ortamını biriyle paylaşma durumu (p=0,006), sağlık problemi varlığı (p=0,004) solunum bozuklukları (p=0,000) ve dikkat-eksikliği-hiperaktivite-bozukluğu varlığı ve polisomnografi ile teşhis edilen uyku bozukluğu (p=0,000) arasında anlamlılık saptandı. Annelerinin sağlığı da önemli bir faktör olarak bulunmuştur. Çocukların sağlıklı bir büyüme ve gelişme dönemi geçirebilmeleri için uyku ihtiyaçlarının sağlıklı bir şekilde karşılanması gerekmektedir. Uyku kalitesi için uyku ve beslenme düzeninin sağlanması önemlidir. Sağlıklı bir uyku düzeni için bireysel ve aile temelli müdahalelerin gerekli olduğu görülmüştür.

INTRODUCTION

Sleep is critical for children's physical, cognitive and emotional development. Problems related to physiological systems such as the gastrointestinal system and respiratory system can affect sleep. For example, respiratory problems such as Obstructive Sleep Apnea (OSA) cause upper airway obstruction during sleep, making it difficult for children to enter a healthy sleep process (1). According to studies, OSA affects approximately 1-5% of children and can lead to growth, learning and behavioral problems (2). In a study conducted on children aged 6-10 years in Turkey, 62.9% of children were found to have sleep problems (3). The most common sleep problems are difficulty falling asleep, night awakenings and sleep-disordered breathing. In addition, it has been reported that sleep-disordered breathing symptoms increase with advancing age and this situation negatively affects the general health of children (19).

Scales can be used to assess sleep quality (20). Sleep scales often help to assess children's sleep patterns and symptoms associated with sleep disorders based on parental observation. However, objective measurement methods such as polysomnography (PSG) are also needed. Thus, it can be used as a supportive tool in screening sleep disorders in larger populations and in clinical evaluations (4). Polysomnography is one of the gold standard methods in the diagnosis of sleep disorders. It evaluates sleep quality by measuring many biophysiological parameters such as brain waves, eye movements, muscle activity, heart rhythm and respiratory patterns during sleep while the child is sleeping (5, 6).

Respiratory problems during sleep can lead to decreased sleep duration, frequent awakenings and sleep interruptions in children and may cause long-term consequences such as attention deficit, learning difficulties and behavioral problems (1). Therefore, early detection and treatment of respiratory problems in children is important. When sleep is considered in line with the United Nations Sustainable Development Goals (SDGs), it is seen that it is an important factor in areas such as health and quality of life, ending hunger

and quality education (7). If sleep is of good quality, the child grows and develops healthily. At the same time, their cognitive, social and emotional characteristics mature. For this reason, it is necessary to carry out studies to improve sleep quality. In this regard, it is important to first determine the presence of the problem and to identify the factors affecting the problem. In this study, the effects of respiratory disorders on sleep quality in children will be discussed and the importance of this relationship in terms of children's general health will be evaluated. At the same time, it will be discussed how approaches to the management of respiratory diseases can play a role in improving sleep quality. Based on this information, our study aims to determine the effect of respiratory problems and nutritional characteristics on sleep quality in children and the factors related to this effect.

MATERIAL AND METHODS

Study design

It is descriptive and cross-sectional.

Research questions

- What is the extent to which the presence of respiratory problems affects sleep quality?
- What factors affect sleep quality in children with respiratory problems?
- Does nutrition affect sleep quality?
- How do parental health and environmental factors affect sleep quality in children with respiratory diseases?

Participants

The study was conducted between October 2023 and July 2024 with children who applied to the pediatric outpatient clinic of a hospital. The population of the study consisted of children who applied to the outpatient clinic within the specified date range, and all children who met the inclusion criteria were selected from the population by non-probability random sampling method. The inclusion criteria were knowing Turkish and being younger than 18 years of age, while the exclusion criteria were cognitive or neurological disease (acute or chronic). The study was completed with 101 children.

Data collection tools

Data were collected using a child information form and the Pediatric Sleep Questionnaire: Sleep-disordered breathing subscale.

Child information form: It consists of 3 sections including information about the child (sociodemographic information, respiratory and nutritional characteristics), information about the family and information about the child's sleep and pattern, and a total of 55 questions.

Pediatric Sleep Questionnaire: Sleep-disordered breathing subscale (PSQ: SBS); It was developed in 2001 and adapted to Turkish in 2011 (21, 22). The scale consists of 22 questions and 4 sub-dimensions (insomnia=4 items, snoring=4 items, attention deficit=6 items and other problems=8 items) in 3-point Likert type. Those who answer yes to the items score 1 point, while other answers are recorded as 0. The number of yes responses in the scale is divided by the number of items. The result ranges from 0.0 to 1.0 and scores above 0.33 are considered positive and indicate the risk of pediatric sleep-related breathing disorder. The total Cronbach's Alpha value of the scale was reported to be 0.83 (22), while it was found to be 0.64 in our study.

Data collection

After obtaining the necessary scale permission and institutional permission, ethics committee approval was obtained. Then, the data were collected by one of the researchers working in the unit where the study would be conducted and taking part in the research team. After verbal and written information was given about the purpose of the study, the study was conducted with those who agreed to participate. Data were collected by face-to-face interview method (about 15-20 minute).

Data analysis

The data obtained from the study were analyzed with a computer- supported statistical program (SPSS, v26). In the first stage, frequency analysis was performed. Mean, minimum, maximum, standard deviation and median values of

continuous data and number and percentages of categorical data were calculated. Normality distributions were examined with Shapiro Wilk test. Then, comparisons between scale mean scores and variables were measured by Chi-Square Test, Ona Way Anova, Kruskal Wallis Test, Mann Whitney U-Test, and Pearson Chi-square test. Significance was accepted at 95% confidence interval.

Ethical aspects of the study

The necessary scale use permission, hospital permission and ethics committee approval (dated 22.11.2022 and numbered 22-131) were obtained before the study. In addition, the parents of the children and the children in a language they could understand were informed about the study and their verbal and written informed consent was obtained. Helsinki Declaration of Human Rights was followed in the study.

RESULTS

The distribution of the characteristics of the children and their comparison with the scale score are shown in Table 1. Accordingly, it was determined that the mean age of the children was 7.3±3.7 years, 52.5% were male and 37.6% attended kindergarten. 70.3% of the children had health problems (esophageal reflux, asthma, bronchitis, hyperactivity, allergic asthma) and 78.2% of those with health problems had respiratory problems and 24.8% used regular medication due to health problems. In addition, 9.9% had attention deficit hyperactivity disorder (ADHD).

Table 2 shows the distribution of sleep characteristics of the children and their comparison with the scale score. Accordingly, it was determined that the children slept for a mean of 1.1±1.14 hours during the day and 8.2±1.36 hours at night. 35.6% of the children woke up at night. 42.6% of the children had sleep problems, but only 4% of them came to the hospital because

Table 1. Distribution of child-related characteristics and comparison with scale score

Characteristics		**Mean±Sd**	**Min-max (Med)**	**PSQ: SBS p**
Age of the child (years)		7.3±3.7	3-17 (6)	*0.167
Number of siblings (including self)		1.5±0.9	1-7 (1)	*0.505
		n	**%**	
Gender	Girl	48	47.5	**0.691
	Boy	53	52.5	
Education level	Kindergarten	38	37.6	***0.179
	Primary School	37	36.6	
	Middle School	16	15.8	
	High School	10	9.9	
Presence of health problems	Yes	71	70.3	**0.004**
	No	30	29.7	
Presence of problems with the respiratory system	Yes	79	78.2	**0.000**
	No	22	21.8	
Presence of ADHD	Yes	10	9.9	**0.000**
	No	91	90.1	
Medication use	Yes	25	24.8	**0.466
	No	76	75.2	
	TOTAL	**101**	**100**	

*Sd: Standard derivation; min: minimum; max: maximum; med: Median; n: number; %: percentage; *One-way Anova; **Mann Whitney U test; ***Kruskal Wallis test; p<0.05*

PSQ: SBS= Pediatric Sleep Questionnaire: Sleep-disordered breathing subscale; ADHD: Attention deficit hyperactivity disorder

Table 2. Distribution of the child's sleep characteristics and comparison with the scale score

Characteristics		**Mean±Sd**	**Min-max (med)**	**PSQ: SBS p**
Daytime sleep duration (hours)		1.1±1.1	0-3 (1)	***0.000**
Night sleep duration (hours)		8.2±1.3	5-10 (8)	*0.130
Number of awakenings from sleep at night		1.2±1.9	0-8 (0)	***0.030**
		n	**%**	
Diagnosis by polysomnography	Yes	16	15.8	****0.000**
	No	85	84.2	
Type of lighting while sleeping	Darkness	75	74.3	**0.160
	Brightness	4	4.0	
	Night light	22	21.8	
Feature of the room where he sleeps	In own room	43	42,6	*****0.006**
	In the same room with siblings	25	24.8	
	In the same room with parents	33	32.7	
Presence of sleep problems	Yes	43	42.6	****0.000**
	No	58	57.4	
Presence of daytime sleepiness	Yes	55	54.5	****0.000**
	No	46	45.5	
Awakening from night sleep	Yes	36	35.6	****0.023**
	No	65	64.4	
Admission to hospital with sleep problems	Yes	4	4.0	**0.357
	No	97	96.0	
Child's sleep routine	Prayers	2	2.0	***0.624
	By itself	45	44.6	
	Reading a book	31	30.7	
	Music	4	4.0	
	The Game	2	2.0	
	Shaking to sleep	3	3.0	
	Hug, kiss	3	3.0	
	Sleeping with your mother	11	10.9	
Sleep support person		Kindergarden / Primary school	Middle school / High school	
	By itself	6 (15.8) / 18 (48.6)	16 (100.0) / 10 (100.0)	******0.000**
	Her mother	22 (57.9) / 10 (27.0)	0 (0.0) / 0 (0.0)	
	Father	0 (0.0) / 1 (2.7)	0 (0.0) / 0 (0.0)	
	One of the parents	10 (26.3) / 8 (21.6)	0 (0.0) / 0 (0.0)	
TOTAL				

*Sd: Standard derivation; min: minimum; max: maximum; med: Median; n; number; 5: percentage; *One-way Anova; **Mann Whitney U test; ***Kruskal Wallis test; ****Pearson Chi-square test; p<0.05*

PSQ: SBS= Pediatric Sleep Questionnaire: Sleep-disordered breathing subscale

of sleep problems, while 15.8% were diagnosed with sleep disorders by polysomnography. 42.6% of the children slept alone in their own room and 74.3% of them slept in the dark. Only 9.9% slept alone in their own bed and room.

Table 3 shows the nutritional characteristics of the children and their comparison with the scale score. Accordingly, it was determined that the mean weight of the children was 23.9±15.08 kilograms and they had 3.3±0.6 main meals and 2.1±0.74 snacks during the day. When the last feeding time at night was analyzed, it was found that 38.6% of the children fed between 20:01-22:00, 28.7% used vitamins, 28.7% had allergies, and dust allergy was reported most frequently with 18.9%.

The distribution of the characteristics of the child's mother and their comparison with the scale score are presented in Table 4.

Table 5 shows the total and subscale mean scores of the "Pediatric Sleep Questionnaire: Sleep-disordered breathing subscale" shows the total and subscale mean scores. Accordingly, the mean total score was 0.22 (min-max: 0.0-0.5). There was a statistically significant difference between the scale score and the presence of health problems (p=0.004), respiratory problems (p=0.000) and ADHD (p=0.000) (Table 1). A statistically significant difference was found between the scale score and daytime sleeping status (p=0.000), daytime sleep duration (p=0.000), nighttime waking status (p=0023), nighttime waking frequency (p=0.030), presence of sleep problems (p=0.000), diagnosis of sleep disorder by polysomnography (X2= 32.168; p=0.000), feature of the room where he sleeps (p=0,006) and having someone with them

Table 3. Distribution of the child's nutrition characteristics and comparison with the scale score

Characteristics		**Mean±Sd**	**Min-max (Med)**	**PSQ: SBS p**
Weight of the child (kilogram)		23.9±15.0	10-74 (18)	*0.260
Number of main meals		3.3±0.6	2-5 (3)	*0.464
Number of snacks		2.1±0.7	1-3 (2)	***0.033**
		n	**%**	
Last feeding at night	18:00-20:00	26	25.7	***0.046**
	20:01-22:00	39	38.6	
	22:01-24:00	26	25.7	
	00:01-02:00	10	10.0	
Vitamin use	Yes	29	28.7	**0.252
	No	72	71.3	
Presence of allergy	Yes	29	28.7	**0.315
	No	72	71.3	
Cause of allergy	Dust	19	66.0	***0.074
	Drugs	3	10.2	
	Walnut	2	6.8	
	Banana	1	3.4	
	Perfume	1	3.4	
	Mosquito	1	3.4	
	Virus	1	3.4	
	Egg White	1	3.4	
TOTAL		**101**	**100**	

*Sd: Standard derivation; min: minimum; max: maximum; med: Median; n; number; 5: percentage; *One-way Anova; **Mann Whitney U test; ***Kruskal Wallis test; p<0,05*

PSQ: SBS= Pediatric Sleep Questionnaire: Sleep-disordered breathing subscale

Table 4. Distribution of characteristics of the child's mother and comparison with the scale score

Characteristics		**Mean±Sd**	**Min-max (med)**	**PSQ: SBS p**
Age of mother		33.3±5.7	24-49 (32)	*0.079
Current stress score		6.8±2.1	1-10 (7)	*0.110
		n	**%**	
Mother's education level	Literate	4	4.0	***0.309
	Illiterate	2	2.0	
	Primary / Secondary School	38	37.6	
	High School	6	5.9	
	University and above	51	50.5	
Number of children	1	44	43.6	***0.191
	2	35	34.7	
	3 and above	22	21.7	
Nurse/midwife support after pregnancy	Yes	21	20.8	**0.020
	No	80	79.2	
Is there support after childbirth	Yes	65	64.4	**0.101
	No	36	35.6	
Husband support	Yes	52	51.5	**0.040
	No	49	48.5	
Health problems in the mother	Yes	28	27.7	**0.001
	No	73	72.3	
Medication use	Yes	29	28.7	**0.001
	No	72	71.3	
Use of maternal vitamins	Yes	26	25.7	**0.362
	No	75	74.3	
The mother's expectation of her own sleep	No expectations	52	51.5	***0.049
	Normal sleep patterns	12	11.9	
	Being sleepy	37	36.6	
In which areas of childcare do you most need help *	Feeding	40	23.4	***0.187
	Bathroom	28	16.4	
	Dressing	9	5.3	
	Sleep	33	19.3	
	Education	38	22.2	
	Breastfeeding	5	2.9	
	Disease	3	1.8	
	Other	15	8.8	
Sleep problems in siblings	Yes	11	10.9	**0.446
	No	90	89.1	
Sibling sleep problem solution	No	96	95.0	***0.858
	It got better when I grew up	1	1.0	
	We haven't found a solution yet	1	1.0	
	With herbal medicine under doctor's supervision	1	1.0	
	Spontaneous	2	2.0	
TOTAL		**101**	**100**	

*Sd: Standard derivation; min: minimum; max: maximum; med: Median; n: number; %: percentage; *One-way Anova; **Mann Whitney U test; ***Kruskal Wallis test; p<0,05; * More than one answer was given.*

PSQ: SBS= Pediatric Sleep Questionnaire: Sleep-disordered breathing subscale

while sleeping (p=0.000) (Table 2). There was a statistically significant difference between the scale score and the number of snacks (p=0.033) and the time of last feeding at night (p=0.046) (Table 3). When the scale score was compared with the characteristics of the child's mother, a statistically significant difference was found between the scale score and the support received from the spouse and health professionals during pregnancy (p=0.020), the presence of health problems in herself (p=0.001), medication use (p=0.001) and expectations from her own sleep (p=0.049).

DISCUSSION AND CONCLUSION

In this study, the links between children's sleep patterns, eating habits, health status, presence of respiratory problems and factors related to their mothers were examined and important findings were obtained. The results of the study were compared and interpreted with similar studies in the literature.

Sleep is one of the basic needs for healthy growth and development of children. When sleep quality is impaired, all biopsychosocial systems are affected both directly and indirectly. There are many intrinsic and extrinsic factors that affect sleep. Extrinsic factors are mostly environmental factors such as noise, heat, light, pillow. Intrinsic factors consist of characteristics related to the child (23). When we look at the factors affecting sleep quality, nutrition can take the lead. Nutrition type (main meal, snack), frequency, duration or content may affect sleep. Especially pre-sleep eating habits may negatively affect sleep (8). Considering the results obtained in our study, it was determined that the frequency of snacks affected sleep quality. Especially the high number of evening snacks and the last snack close to sleep negatively affected sleep quality and caused respiratory problems during sleep. Other studies have also reported a relationship between diet and sleep (24, 25). In particular, it has been reported that irregular eating habits and excessive consumption of snacks may negatively affect sleep quality (26). One of the factors affecting sleep patterns may be the content of dinner or snacks. It has been reported that carbohydrate-dominated dinners may shorten sleep duration, whereas a balanced diet in terms of protein and healthy fats is associated with better sleep (16). This information shows that children's snacks or main meals should be organized considering their sleeping hours. In our study, the frequency of snacks and the time of the last meal before bedtime were found to affect the scale score (Table 3). It should be kept in mind that establishing a regular sleep and nutrition routine is important for the regularity of the child's life as well as growth and development.

Among the factors affecting sleep quality is whether the child meets his/her daily sleep needs. It is important that the child completes a daily, age-appropriate sleep period (27). Sleep can be in the form of daytime and nighttime sleep, or only nighttime sleep as the age progresses. Daytime sleep time and nighttime sleep time should be regular and balanced. If the child takes daytime naps at different times and for varying durations every day, or if daytime naps are skipped when they should be taken, this directly affects nighttime sleep. The shorter the time between daytime sleep and nighttime sleep, the routine of falling asleep and waking up at night may be disrupted (28). In our study, it was determined that the daytime sleep duration of sleep quality

Table 5. Pediatric Sleep Questionnaire: Sleep-disordered breathing subscale total and subscale mean scores

Questionnaire		**Mean±Sd**	**Min-Max**	**Med**
PSQ:SBS	Total	0.2±0.1	0.0-0.5	0.2
	Snoring	0.1±0.2	0.0-1.0	0.0
	Inattention	0.0±0.2	0.0-1.0	0.0
	Sleepiness	0.4±0.2	0.0-1.0	0.5
	Other problems	0.2±0.1	0.0-0.6	0.1

Sd: Standard derivation; Min: minimum; max: max: maximum; Med: median

PSQ: SBS= Pediatric Sleep Questionnaire: Sleep-disordered breathing subscale

was short and the child woke up at least once a night. Studies on sleep disorders have revealed that children who wake up frequently during the night have negative effects on both cognitive and physical development (10). It has also been reported that inadequate sleep duration and quality are closely related to school achievement, attention span and emotional regulation in children (29). This suggests that there is a balance between daytime sleep and nighttime sleep.

Of course, it is not correct to attribute sleep quality only to sleep routine or regularity. The presence of a disease in the child may also affect this (10). In our study, it was determined that the majority of the children had health problems (physical or psychosocial) and 78.2% of them had a disorder related to the respiratory system. In addition, these problems were found to affect sleep quality ($p<0.001$). In previous studies, respiratory disorders and attention deficit-hyperactivity disorders (ADHD) have been shown to negatively affect sleep duration and quality (12). In particular, obstructive sleep apnea syndrome has been reported to be associated with daytime sleepiness and decreased cognitive performance in children (11). In children with ADHD, problems such as difficulty falling asleep, frequent awakenings and short sleep duration were reported to be more common (30). Considering that frequent awakenings at night affected sleep quality in our study, it can be said that this is an issue that should be emphasized.

Not only physical factors but also psychosocial factors can affect sleep quality in children (31). The child's sleep routine and the characteristics of the sleeping environment affect this situation (32). Children need a routine and order during growth and development (33). Based on this, it is important to establish a sleep routine as of infancy. In the sleep routine, organizing the sleep environment is the foremost practice. Answers to questions such as where the child sleeps, with whom and how the child sleeps should be organized. If the child is young, he/she may need a pre-sleep routine and support while sleeping (parent, sleeping object, toy, reading a book, listening to music). These make it easier for the child to fall asleep and improve sleep quality (29). In our study, it was determined that the average age of the children was 7 years, 74.3% of them slept in the dark, 29.7% read books before sleep, 32.7% slept alone in their own room and 24.8% slept in the same room with their siblings. It was also determined that the sleep quality of children was affected by the people they shared their rooms with and the support of a caregiver during sleep (49.5% maternal support). In the literature, it has been reported that children sharing a room with their parents may create a sense of security, especially at an early age, but may delay the development of independent sleep habits (13). At the same time, bedtime routines (e.g., a regular bedtime, reading books and avoiding electronic devices) have been shown to improve sleep quality in children (34). Although most of the children in our study were found to have a bedtime routine, the number of children who slept in the same room with their parents was also high, and the lower-than-average sleep quality (PSG: SBS = 0.2 points) was attributed to this. In line with this information, it is important to diagnose the presence of a sleep problem and to make improvements accordingly. Sleep disorders can be diagnosed by polysomnography. However, as reported in the literature, the rate of sleep disorder diagnosis was very low in our study (15.8%). Among the reasons for this, it is thought that parents do not perceive sleep problems as a disease, and the findings of our study are in this direction. In addition, it is thought that the effect of lack of sleep routine on sleep disorders is not known.

The knowledge of parents, especially the mother, who is the primary caregiver, is important in establishing a sleep routine. In addition, it is known that the psychological and physical health status of mothers affects their role in child care and this is reflected in children's sleep habits (15). In particular, it has been reported that mothers' depression and anxiety levels may directly affect their children's sleep quality (14). When the findings related to the mothers were analyzed, it was determined that 27.7% of the mothers had health problems, about half of them had insufficient sleep and almost all of them needed support in child care. In previous

studies, it has been emphasized that mothers' sleep deprivation is linked to children's sleep patterns and that family stress can negatively affect this process (17). In particular, it has been reported that the importance that parents attach to sleep is a critical factor in determining the duration and quality of children's sleep (18).

In conclusion, it was determined that children's existing health problems, especially respiratory problems, the presence of attention deficit hyperactivity disorder, the presence of daytime sleep and duration of sleep, the type of lighting while sleeping, sharing the sleeping room and the presence of a supportive person while sleeping, night waking status and frequency of waking, the presence of sleep problems and having a diagnosis of sleep disorder with polysomnography affected the scale score. It was also found that the number of snacks and feeding time of the child also affected the scale score.

The findings of our study are in line with the United Nations Sustainable Development Goals (SDG) goal 3: "Health and Quality of Life". At the same time, considering the need to support children's mental health and psychosocial well-being, which is emphasized by the World Health Organization (WHO) and the United Nations Children's Fund (UNICEF), our study findings are in parallel (35). A healthy growth and development process (biopsychosocial) is necessary for health and quality of life, and it is important that nutrition and sleep requirements are met in a healthy, equal and balanced manner.

In line with this information, it can be said that sleep is an important factor in maintaining healthy growth and development. It can also be concluded that nutrition is also an important component. Nutrition affects sleep, sleep affects growth and development, and this turn continues throughout life with rapid direct or direct effects. For healthy sleep and nutrition behaviors, it may be recommended to support children starting in the family, especially to adopt family-child centered approaches. Such studies on children's sleep patterns and health status contribute to the realization of the SDGs and support efforts to build a healthier and more sustainable future. Future research is recommended to include interventions that improve individual sleep habits. Increasing the number of studies including children's food diaries in which nutrition-related characteristics are examined in depth may facilitate the planning of strategies to address sleep-nutrition related problems.

Limitations of the study

The limitation of the study is that it was a single-center study. Another limitation of the study is that children's food diaries were not kept. Although the lack of similar studies comparing polysomnography, nutrition and sleep-related characteristics in children while evaluating sleep quality limits the possibility of discussion, the fact that it is one of the pioneering studies in the literature is a strength of the study.

Author contributions

Conceptualization: FG, SY, AS and AA; Data curation: FG and AS; Formal Analysis: FG, SY, AS and AA; Funding acquisition: FG, SY, AS and AA; Research: FG, AS and AA; Methodology: FG, SY, AS and AA; Project management: FG, SY, AS and AA; Resources: FG, SY, AS and AA; Software: FG, SY, AS and AA; Supervision: FG, SY, AS and AA; Verification: FG, SY and AS; Visualization: FG and AA; Writing - original draft: FG, SY, AS and AA

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Conflict of interest

The authors declare that there is no conflict of interest.

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TOROS UNIVERSITY
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Research Article / Araştırma Makalesi

Acceptability and Nutritional Potential of Instant Pap (Ogi) Enriched with Landolphia togolana Stem Powder

Landolphia togolana Gövde Tozu ile Zenginleştirilmiş Hazır Mısır Lapası'ın (Ogi) Kabul Edilebilirliği ve Besin Potansiyeli

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Abstract

The study assessed the acceptability and nutritional potential of instant pap (*Ogi*) enriched with *L. togolana* stem powder (LTSP). Powdered *Sorghum* seed and *L. togolana* stem bark was used to create 4 formulas with different concentration combinations: IOF (100% *Ogi* flour); LIO1 (95% *Ogi* flour + 5% LTSP); LIO2 (90% *Ogi* flour + 10% LTSP) and LIO3 (85% *Ogi* flour + 15% LTSP). Proximate analysis was determined using the AOAC method, and the concentrations of vitamins and minerals were determined using AAS. The sensory attributes results suggested that LIO1 instant *Ogi* with 5% LTSP maintained acceptability (8.02±0.79). Additionally, enriching *Ogi* with LTSP significantly ($p < 0.05$) increased its fiber, ash, and carbohydrate contents (from 3.46% to 3.90%, 1.39% to 2.97%, and 70.03% to 73.55%, respectively), while decreasing its moisture, fat, and protein contents (from 9.07% to 7.00%, 3.42% to 2.06%, and 12.65% to 10.62%, respectively). The enriched pap (*Ogi)* has higher ($p<0.05$) vitamins (B1, B2, B3, B6, B9, C, and E), and minerals (Zn, Fe, Ca, P, and K) contents. The study concluded that *L. togolana* stem bark powder increases the nutritional content of the instant *Ogi* and its acceptability.

Özet

Bu çalışma, *L. togolana* gövde tozu (LTSP) ile zenginleştirilmiş hazır mısır lapasının (Ogi) kabul edilebilirliğini ve besin potansiyelini değerlendirmiştir. Toz halinde sorgum tohumu ve *L. togolana* gövde kabuğu kullanılarak farklı konsantrasyon kombinasyonlarına sahip 4 formül oluşturulmuştur: IOF (%100 Ogi unu); LIO1 (%95 Ogi unu + %5 LTSP); LIO2 (%90 Ogi unu + %10 LTSP); ve LIO3 (%85 Ogi unu + %15 LTSP). Yaklaşık besin analizleri AOAC yöntemi kullanılarak yapılmış; vitamin ve mineral konsantrasyonları ise AAS ile belirlenmiştir. Duyusal özellikler sonuçları, %5 LTSP içeren LIO1 numaralı hazır Ogi'nin kabul edilebilirliğini koruduğunu göstermiştir (8.02±0.79). Ayrıca, LTSP ile zenginleştirilen Ogi'nin lif, kül ve karbonhidrat içeriği anlamlı derecede artmıştır (sırasıyla %3.46'dan %3.90'a, %1.39'dan %2.97'ye ve %70.03'ten %73.55'e), buna karşılık nem, yağ ve protein içeriği azalmıştır (sırasıyla %9.07'den %7.00'ye, %3.42'den %2.06'ya ve %12.65'ten %10.62'ye). Zenginleştirilmiş lapa (Ogi), daha yüksek ($p<0.05$) vitamin (B1, B2, B3, B6, B9, C ve E) ve mineral (Zn, Fe, Ca, P ve K) içeriğine sahiptir. Çalışma, *L. togolana* gövde kabuğu tozunun hazır Ogi›nin besin içeriğini ve kabul edilebilirliğini artırdığını sonucuna varmıştır.

INTRODUCTION

Fermented maize product, commonly known as pap (*Ogi* in Yoruba), is a widely consumed weaning and breakfast cereal in sub-Saharan Africa. It is traditionally made using maize, sorghum, or millet (1). The preparation process involves soaking cleaned grains in water at ambient temperature (approximately 25±2°C) for two to three days. Afterward, the steeping water is drained, and the fermented grains are washed and wet-milled. The bran is separated through wet sieving, allowing the resulting slurry to settle and ferment naturally for another two to three days. The fermented wet slurry is then transformed into a ready-to-eat gruel by mixing it with hot water. Consumers often enhance its taste by adding sweeteners such as honey or sugar (2).

Ogi, also known as akamu or pap, holds significant cultural and nutritional importance in Nigeria (3). It is consumed by many households, particularly in the southwestern region (4). Sorghum is a nutritious grain that offers several health benefits. However, like other grains, Sorghum may lack certain essential nutrients compared to a well-rounded diet. Research has shown that Sorghum lacks lysine, vitamin B12, folate, and ascorbic acid (vitamin C), and it is relatively low in minerals such as calcium, iron, and zinc compared to some other grains. Several studies revealed that *Ogi* can be enriched with date palm fruits, acha-tamba, soy peptides, and other seeds and spices. Ilori *et al.* (5) investigated the nutritional composition and acceptability of powdered *Ogi* enriched with date palm fruits, revealing that samples with higher date inclusion were favored and considered nutrient-dense, suggesting their potential to alleviate hunger (5). Also, Ogori *et al.* (6) examined *Ogi* enriched with acha-tamba and hydrolyzed soy peptides. The finding showed that increased inclusion of these ingredients positively affected moisture content, protein, ash, and various functional properties, while sensory evaluation showed that panelists preferred moderate inclusions (6).

Landolphia togolana, a climbing plant belonging to the Apocynaceae family, is commonly referred to as vine rubber. The genus *Landolphia* comprises approximately 64 species distributed across Africa. In Nigeria, it is known by various local names, including "Eso/Utu" in Igbo, "Mba/Alakitipa" in Yoruba, "Jabajaba" in Akoko, and "Ciwa" in Hausa (7). Scientific research has demonstrated that different parts of *L. togolana* exhibit properties such as anti-inflammatory, anti-nociceptive, antioxidant, antimicrobial, and hepatoprotective effects (8, 9, 10). The stem of *L. togolana* also contains various secondary metabolites, such as alkaloids, flavonoids, and tannins, which have been shown to have potential medicinal properties (11). The production of instant '*Ogi*' has emerged due to the rising demand for fast foods among the urban population. It is popular due to its affordability, ease of preparation, and versatility as a meal option for children and adults (12). However, traditional *Ogi* has limitations in terms of its nutritional composition. It contains relatively

low levels of essential nutrients such as proteins, vitamins, and minerals, making it insufficient to fully meet the dietary needs for optimal health (13, 14). This poses a particular concern for vulnerable groups, including children, pregnant women, and lactating mothers, who have higher nutrient requirements (15). Ojo & Enujiugha (1) reported that *Ogi* can be found in different kinds of cereal, including Sorghum, maize, millet, etc. However, the nutritional composition of traditional *Ogi* is relatively low, and it may not adequately meet the nutrient requirements of individuals, especially those with specific dietary needs. As a result, there is a growing interest in developing enriched variants of *Ogi* to enhance its nutritional value. A promising option for enrichment is *Landolphia togolana* stem powder, known to be a rich source of essential nutrients, including vitamins, minerals, and dietary fiber. Consequently, this study seeks to evaluate the acceptability of instant *Ogi* enriched with *L. togolana* stem powder.

MATERIALS

Plants collection

The raw materials used in this study were red sorghum (*Sorghum bicolor*) and the stem of *Landolphia togolana*. The sorghum was sourced from the Oja-Oba market (coordinates: 8° 29′ 59.99″ N, 4° 32′ 59.99″ E) in Ilorin, Kwara State, while the *L. togolana* stem was procured from Adelabu Salami's farm located in Owo (coordinates: 7°11′46.32″ N, 5°35′12.52″ E), Ondo State, Nigeria. The plant samples were identified and authenticated at the Department of Plant Biology and Biotechnology, University of Benin, Nigeria, by Prof. Akinobosun, a taxonomist. Voucher numbers UBH-S289 for sorghum and UBH-L200 for *Landolphia* were assigned.

METHODS

Plant preparation

The stems were collected in a clean container. Impurities were removed by rinsing thoroughly with clean water. The stems were dried naturally under direct sunlight in a well-ventilated area until they became crispy and bristles. The stems were broken into small pieces using mortar and pestle, then ground to powder using a mechanical blender, and then it was sieved using a fine mesh (85 microns) to remove coarse particles or fiber. The powdered sample was stored in a closed container until further use.

Preparations of enriched instant *Ogi* with *L. togolana* stem powder

The sorghum grains were sorted, cleaned, and steeped for 48 hours at 25℃. It was wet-milled and left to ferment and settle for 72 hours. The fermented product was decanted to make *Ogi* cake. As previously reported, the Sorghum water extract (*Ogi* cake) was dewatered and dried for 11 hours at 50℃ (16). Dry-milling was done, and the Ògi flour was cooled. The powdered *Ogi* was enriched by adding different amounts of the powdered stem of *L. togolana* to prepare 4 formulas used for this study (Table 1).

Table 1. Composition Ratios of Four Potential Formulations

The proportion of blend ratio (%)		
Sample code	Instant *Ogi* flour (%)	*Landolphia togolana* stem powder (%)
IOF	100	-
LIO1	95	5
LIO2	90	10
LIO3	85	15

KEY:

IOF = 100% Instant *Ogi* flour

LIO1: 95% instant *Ogi* flour and 5% *Landolphia togolana* stem powder

LIO2: 90% instant *Ogi* flour and 10% *Landolphia togolana* stem powder

LIO3: 85% instant *Ogi* flour and 15% *Landolphia togolana* stem powder

Data in Table 1 show the amounts of *L. togolana* stem bark extract and *Ogi* (*S. bicolor* seed flour) used to formulate the four formulations evaluated.

Proximate Analysis

The samples were subjected to proximate analysis, where the ash, crude fiber, and moisture contents were measured according to the AOAC method (17). Crude protein was determined using the Kjeldahl method, fat was extracted using Soxhlet extraction, and carbohydrates were calculated by difference.

Moisture Content Determination

The Petri dishes were thoroughly washed and then dried in an oven. After drying, the dishes were cooled in a desiccator, and their weights, along with the lids, were measured on a balance. A 2.0 g sample of each test material was placed into the empty dishes and spread evenly. The weight of the samples and the dishes were recorded. The samples were then placed in the oven and dried at 105°C for 3 hours. After this period, the samples were cooled in a desiccator, weighed again, and returned to the oven for further drying until a constant weight was achieved.

The dried sample and Petri dishes were weighed again, and the weight was recorded. The percentage moisture content was calculated using the following formula:

$$\% \, \boldsymbol{Moisture} = \left(\frac{\boldsymbol{W2 - W3}}{\boldsymbol{W2 - W1}}\right) \times \boldsymbol{100}$$

Where:

- **W1**: Initial weight of the Petri dish
- **W2**: Weight of the sample and Petri dish before drying
- **W3**: Weight of the sample and Petri dish after drying

Crude Ash Content Determination

The crucibles and their lids were placed in the furnace and heated at 550°C for 2 to 3 hours to ensure the removal of impurities. After heating, the crucibles were allowed to cool in a desiccator for 30 minutes, and the weight of the crucible and lid was recorded. Then, 5 g of the sample was weighed into the crucibles, and a few drops of glycerol were added, mixed thoroughly, and then ashed in a muffle furnace at 550°C for 4 to 5 hours until a whitish-grey residue was formed. The crucibles were cooled in the desiccator and reweighed. The percentage of ash content was calculated using the formula:

$$\% \, \boldsymbol{Total \; Ash} = \left(\frac{\boldsymbol{W3 - W1}}{\boldsymbol{W2 - W1}}\right) \times \boldsymbol{100}$$

Where:

- **W1** = Weight of the dish
- **W2** = Weight of the dish + sample before ashing
- **W3** = Weight of the dish + sample after ashing

Lipid Content

The crude fat content of the sample was determined using a Soxhlet extractor, equipped with a reflux condenser and a distillation flask (17). All glassware was rinsed with petroleum spirit, drained, and dried in an oven at 102°C for 30 minutes before being cooled in a desiccator. A 2.0 g sample of each material was placed in the fat extractor thimble, which was plugged with cotton wool at the bottom, and positioned in the appropriate chamber of the extractor. The distillation flask was filled two-thirds full with n-hexane and heated using a heating mantle to initiate boiling. The distillate was collected until the extractor siphoned after 4 hours. Following this, the n-hexane was recovered into a clean container, and any remaining solvent was evaporated in the oven at 70°C. The distillation flask was then cooled in a desiccator, and its final weight was recorded. The amount of oil extracted was determined by calculating the difference between the initial and final weights of the sample (17).

It can be represented as:

$$\% \, \boldsymbol{Crude \; Fat} = \left(\frac{\boldsymbol{W2 - W1}}{\boldsymbol{Weight \; of \; sample}}\right) \times \boldsymbol{100}$$

Where:

- **W2** = Weight of the receiver flask and fat
- **W1** = Weight of the empty receiver flask

Crude Fiber

Two grams (2g) of each of the samples were defatted during fat analysis. The defatted samples were boiled in 200ml of 1.25% H_2SO_4 solution under reflux for 30 minutes. The samples were washed with several portions of hot (boiling) water using a two-fold muslin cloth to trap the particles (residue). The residues were carefully transferred back to the flask and 200ml of 1.25% NaOH solution was added to it. Again, the samples were boiled for 30 minutes and washed as before with hot water. Then they were transferred to a weighed porcelain crucible and dried in the oven at 105°C for 3 hours. After cooling in a desiccator, they were weighed and then put in a muffle furnace and burnt at 550°C for 4 hours until they became ash. Again, the samples were cooled in a desiccator and reweighed.

$$\%\ \boldsymbol{Crude\ Fibre\ Content}\ (\%) = \left(\frac{\boldsymbol{Weight\ of\ samples\ after\ ashing}}{\boldsymbol{Weight\ of\ sample}}\right) \times \mathbf{100}$$

Protein Content

Two grams of each sample were placed into a digestive flask, followed by the addition of 5 g of Kjeldahl catalyst and 20 mL of concentrated H_2SO_4. A blank sample, prepared with the same constituents, was also set up. The flask was positioned at an incline and gently heated until the solution became clear. This process was carried out in a fume cupboard. After digestion, the flask was removed from the heat, allowed to cool, and then diluted with 60 mL of distilled water. The flask was then transferred to a micro Kjeldahl analyzer (distillation unit), where 40% NaOH was introduced. The mixture was heated to release ammonia, which was distilled into a conical flask containing 25 mL of 4% boric acid for 15 minutes, forming an ammonium borate solution. This solution was titrated against 0.1M HCl until a purplish-grey endpoint was reached. The same procedure was followed for the blank solution. Protein content was calculated using the formula below:

The percentage of nitrogen is calculated using the formula:

$$\%\ \boldsymbol{Nitrogen} = \left(\frac{(\boldsymbol{A} - \boldsymbol{B}) \times \boldsymbol{N} \times \mathbf{14.007}}{\boldsymbol{W}}\right) \times \mathbf{100}$$

Where:

- **A** = Volume of 0.1M HCl (in mL) used for the sample
- **B** = Volume of 0.1M HCl (in mL) used for the blank titration
- **N** = Normality of HCl
- **W** = Weight of the sample (in grams)
- **14.007** = Atomic weight of nitrogen
- **6.25** = Protein nitrogen conversion factor

The percentage of crude protein is then calculated as:

$$\%\ \boldsymbol{Crude\ Protein} = \boldsymbol{Nitrogen} \times \boldsymbol{Conversion\ Factor}$$

Carbohydrate

Carbohydrate content was determined using the difference method, as outlined by (18). The moisture, fat, protein, and ash content percentages of each sample were summed up and subtracted from 100, as follows:

Carbohydrate content = 100 – [protein (%) + fat (%) + moisture (%) + ash (%)].

Determination of the vitamin content of the samples

Vitamin A content determination

The Vitamin A content in the sample was measured using Pearson's method (19). First, one gram of the ground sample was macerated with 20 mL of petroleum ether, then the mixture was decanted into test tubes and evaporated to dryness. The residue was treated with 0.2 mL of

a chloroform-acetic anhydride solution (1:1, v/v), followed by 2 mL of a TCA chloroform solution (1:1, v/v). The absorbance was then recorded at 620 nm. Vitamin A standards were prepared using the same method, and their absorbances were measured at the same wavelength. The Vitamin A concentration in the samples was calculated by extrapolating from the standard curves.

Vitamin C content determination

The Vitamin C content was analyzed using ultraviolet spectrophotometry as outlined by Rahman et al. (20). In this method, 1 gram of each sample, a 1 mM ascorbic acid stock solution (used as a standard), and a 1 mM trichloroacetic acid (TCA) solution (used as a blank) were placed into separate test tubes. Each tube then received 10 mL of TCA solution, followed by 1 mM of dinitrophenyl hydrazine-thiourea-copper sulfate reagent. The test tubes were capped and incubated in a water bath at 37°C for 3 hours. After incubation, the tubes were chilled in an ice bath with gentle shaking for 10 minutes. Subsequently, 2 mL of cold 12 M H_2SO_4 was added to each tube. The spectrophotometer was set to zero absorbance using the blank at 520 nm, and the absorbances of the standards and samples were measured at the same wavelength.

Vitamin D content determination

A 1 g sample of each was extracted using 5 mL of chloroform-methanol (1:9) and spun at 3500 rpm. The clear solutions were then pipetted into test tubes, and their absorbances were measured at 264 nm using a UV spectrophotometer. Blank and standard vitamin D solutions were also prepared for comparison. The vitamin D content was determined as follows:

Where A sample represents the absorbance of the test sample, A_standard refers to the absorbance of the standard solution, A_blank is the absorbance of the blank, and Conc_standard is the concentration of the standard in mg/100g.

Vitamin E (α-tocopherol) Determination:

A widely used colorimetric method for quantifying α-tocopherol is based on its reducing properties. In this procedure, α-tocopherol reduces ferric chloride (Fe^{3+}) to ferrous chloride (Fe^{2+}), which then reacts with 2,2′-bipyridyl to form a red complex. The intensity of this red color is proportional to the concentration of α-tocopherol in the sample and can be measured spectrophotometrically at 520 nm (21).

Vitamin K (Phylloquinone) Determination:

For vitamin K analysis, a colorimetric method involves the reaction of phylloquinone with 2,4-dinitrophenylhydrazine (DNPH) to form a hydrazone derivative. This derivative exhibits a characteristic color that can be quantified spectrophotometrically. The absorbance measured at a specific wavelength correlates with the vitamin K concentration in the sample (22).

Vitamin B-Complex content determination

The microbiol*ogi*cal assay method for determining vitamin B complex levels involves using *Lactobacillus casei* (ATCC 7469) as the test organism. This bacterium is cultivated in a nutrient broth medium enriched with a vitamin B complex-free soy hydrolysate. The sample is serially diluted and added to the nutrient broth in a sterile 96-well microplate. The microplate is then incubated for 18–24 hours at 37°C in a CO_2 incubator. After incubation, the growth of *L. casei* is measured using a spectrophotometer at a wavelength of 600 nm. The vitamin B complex content is determined by comparing the growth of the test organism with that of a known standard solution. This method is based on the work of (23), who developed a modified medium for *Lactobacillus casei* to assay B vitamins. Additionally, the microbiol*ogi*cal assay of folic acid derivatives using *Lactobacillus casei* has been documented in clinical chemistry studies (24).

Mineral Concentration Determination

Reagents: Analytical grade nitric acid (HNO_3) and 70% perchloric acid ($HClO_4$), both supplied by Fischer Scientific, were used for the wet digestion of the samples. All solutions were prepared with deionized water, and all glassware

was thoroughly cleaned and rinsed before use.

Standard Preparation: Stock standard solutions of 1000 ppm were diluted to prepare calibration standards at three to five different concentrations for each mineral to create a calibration curve.

Procedure: To start the mineral analysis, approximately 0.2 g of the sample was placed in a 100 mL volumetric flask. Four milliliters of HNO_3 were added, and the flask was left to stand for a few hours. The mixture was then heated in a water bath until the red fumes from the nitric acid dissipated. After cooling to room temperature, 4 mL of perchloric acid was added, and the flask was heated again to evaporate the contents. Once evaporation was complete, the sample was filtered using Whatman No. 42 filter paper, and the volume was adjusted to 100 mL with distilled water. Mineral concentrations were measured using atomic absorption spectroscopy (Shimadzu), with hollow cathode lamps for Zn, K, Mg, Ca, Mo, Na, Mn, Fe, Cu, and P as the radiation source. Air-acetylene was used as the fuel, and all samples and standards were analyzed in duplicate.

Sensory Analysis

The sensory evaluation of the enriched instant Ogi samples was conducted using a 9-point hedonic scale, where 1 = dislike extremely and 9 = like extremely. The evaluation was carried out in a well-lit and ventilated sensory laboratory under controlled conditions to minimize external influences on the panelists' perceptions. A total of 30 semi-trained panelists, consisting of students and staff members familiar with cereal-based foods, were recruited for the sensory evaluation. The panelists were selected based on their availability, willingness to participate, and their ability to distinguish basic sensory attributes. Before the evaluation, they were briefed on the purpose of the study and the evaluation procedures. Each Ogi sample was prepared following the same standardized cooking procedure to ensure consistency. The samples were cooked into a semi-solid gruel by mixing 50g of Ogi flour with 250mL of boiling water, stirring continuously until a smooth, homogenous texture was achieved. The gruel was allowed to cool to a comfortable tasting temperature (approximately 45°C). The samples were presented in coded white disposable cups to prevent bias, and the order of presentation was randomized to eliminate positional effects. Panelists were provided with clean drinking water and plain crackers to cleanse their palates between samples. The panelists assessed the samples based on colour, aroma, texture, taste and overall acceptability.

Method of Data Analysis

Panelists recorded their responses on structured sensory score sheets using the 9-point hedonic scale. The collected data were analyzed with Statistical Package for Social Sciences (SPSS) Software, version (25.0). The results were expressed in mean and standard deviation and Analysis of Variance (ANOVA) was used determine significant differences among the samples. Duncan's Multiple Range Test (DMRT) was used for mean separation at $p < 0.05$ significance level.

RESULTS AND DISCUSSION

Proximate Analysis Result

Most foods are supplemented to produce better acceptance and dietary enrichment with increased nutritional functionality, leading to better dietary benefits. In this study, dried and powdered extract of Sorghum was enriched with *Landolphia togolana*, a known medicinal with high amounts of minerals and vitamins. The data in Table 2 revealed the proximate parameters of the enriched instant *Ogi* with *L. togolana.* The results revealed that the moisture content of the samples varied between 7.00% and 9.07%. Interestingly, the IOF exhibited the highest moisture content ($p<0.05$) at 9.07 ± 0.08%, while the LIO samples showed lower moisture contents, ranging from 7.00 ± 0.01% to 7.20 ± 0.01%. The decrease in moisture content with the inclusion of *L. togolana* stem powder indicates that the powder may have functioned as a moisture barrier, thereby reducing the water absorption capacity of the *Ogi* flour, which is in line with (25).

Fat Content Results

The fat content of any food is critical as it contributes to the product's nutritional value and sensory attributes. In this study, the fat content of the samples ranged from 2.06% to 3.42%. The IOF had the highest (p<0.05) fat content (3.42 ± 0.16%), while the LIO3 sample had the lowest fat content (2.06 ± 0.01%). The gradual reduction in fat content with the incorporation of *L. togolana* stem powder might be a result of lower fat content of the stem powder itself, this is similar to the result obtained by (26).

Fiber Content Results

Fiber is an essential dietary component that aids digestion and improves overall gut health. The quality of crude fat in the samples was lower than the 10 g/100 g recommended by the Food and Agriculture Organization (FAO) (27). The fiber content of the samples ranged from approximately 3.46% to 3.90%. Interestingly, the LIO1 samples generally exhibited slightly higher fiber content than the IOF. Among the LIO1 samples, LIO2 and LIO3 showed the highest (p<0.05) fiber content (3.86 ± 0.01% and 3.90 ± 0.02%, respectively). This indicates that the stem powder might have contributed additional dietary fiber to the *Ogi* flour, making it a potentially healthier option; this was in agreement with (28) that enriched maize *Ogi* flour enriched with *Moringa oleifera (M. oleifera)* seed to improve the nutritional quality. All the formulations are considered beneficial products because fiber aids in promoting bowel movement, thereby helping to prevent gastrointestinal disorders (29, 30).

Protein Content Evaluation

Protein is a vital nutrient required to grow and repair body tissues. The protein content of the samples varied between approximately 10.57% and 12.65%. The protein content slightly decreased as the *L. togolana* stem powder percentage increased (p>0.05). This decrease in protein content might be due to the stem powder's relatively lower protein content than the *Ogi* flour. This is similar to the work of (5), who enriched powdered *Ogi* with date palm. The results indicated that the protein content of the samples decreased as the proportion of date fruit increased, which contrasts with the findings of (6).

Ash Content Result

Ash content measures the mineral content present in the sample and indicates the overall mineral composition. The ash content of the samples ranged from approximately 1.39% to 2.97%. The IOF had the lowest ash content (1.39 ± 0.19%), while the LIO3 sample had the highest (p<0.05) ash content (2.97 ± 0.03%). The increase in ash content with the addition of *L. togolana* stem powder suggests that the powder might be a source of minerals, contributing to the overall mineral content of the enriched *Ogi* sample. This aligns with the research carried out by (5), who enriched powdered *Ogi* with date palm fruits to improve its nutritional content. In other words, the substantial increase (p<0.05) in ash content can be attributed to the high mineral content of date palm fruits (29).

Table 2. Proximate analysis of enriched instant *Ogi* sample with *L. togolana* stem powder

Sample (%)	IOF	LIO1	LIO2	LIO3
Moisture	9.07±0.08^{a}	7.20±0.01^{b}	7.05±0.09^{c}	7.00±0.01^{c}
Fat	3.42±0.16^{a}	2.70±0.03^{b}	2.13±0.01^{c}	2.06±0.01^{c}
Fibre	3.46±0.11^{d}	3.52±0.08^{c}	3.86±0.01^{b}	3.90±0.02^{a}
Protein	12.65±0.04^{a}	10.57±0.02^{c}	10.61±0.03^{b}	10.62±0.01^{b}
Ash	1.39±0.19^{c}	2.87±0.05^{b}	2.87±0.02^{b}	2.97±0.03^{a}
Carbohydrate	70.03±0.03^{a}	73.15±0.06^{b}	73.50±0.02^{b}	73.55±0.02^{b}

Key: **IOF =** 100% Instant *Ogi* flour; **LIO1**: 95% instant *Ogi* flour and 5% *Landolphia togolana* stem powder; **LIO2**: 90% instant *Ogi* flour and 10% *Landolphia togolana* stem powder and **LIO3**: 85% instant *Ogi* flour and 15% *Landolphia togolana* stem powder.

Note: *Values are presented as Mean ± SD (Standard Deviation), n = 2. Values with different superscripts within the same row are significantly different at (p<0.05).*

Carbohydrate Content Result

Carbohydrates are the primary energy source in the human diet. The carbohydrate content of the samples ranged from approximately 70.03% to 73.55%. It was observed that the LIO1 samples generally had slightly higher ($p<0.05$) carbohydrate content compared to the IOF. This increase might be attributed to the dilution effect of the stem powder on the *Ogi* flour. This is similar to the reports from studies in which Sorghum-*Ogi* was enriched with plantain flour (31). *Sorghum-Ogi* has been fortified with several food materials to increase its nutritional value.

Vitamins Content Determination

The results presented in Table 3 highlight the impact of adding *L. togolana* stem powder on the levels of vitamins B1, B2, B3, B6, B9, C, and E in enriched instant *Ogi*. The concentration of vitamin B1 (thiamine) showed a slight increase with the inclusion of *L. togolana* stem powder. The highest concentration of 0.47 ± 0.01 mg/100g was observed in sample LIO3, representing a significant ($p<0.05$) increase when compared to the control sample, IOF (0.38 ± 0.00 mg/100g). This enrichment of vitamin B1 in LIO3 suggests that *L. togolana* stem powder could be a potential source of thiamine.

The results revealed a progressive increase in vitamin B2 (riboflavin) content with adding *L. togolana* stem powder. LIO3 demonstrated the highest concentration of 0.22 ± 0.01 mg/100g, which was significantly higher ($p<0.05$) compared to both the control (IOF) and the other enriched samples (LIO1 and LIO2). This suggests that *L. togolana* stem powder has a considerable impact on enhancing riboflavin levels in instant *Ogi*. This agrees with the work of (32), who fortified Sorghum flour with roasted Bambara groundnut. The study revealed a significant increase in the concentration of riboflavin.

All enriched samples (LIO1, LIO2, and LIO3) showed comparable vitamin B3 (niacin) concentrations, ranging from 2.70 ± 0.00 to 2.88 ± 0.00 mg/100g. These concentrations did not differ significantly ($p>0.05$) from the control (IOF) sample, which had a value of 2.69 ± 0.00 mg/100g. The study indicates that adding *L. togolana* stem powder did not significantly influence niacin concentrations in the instant *Ogi*. This differs from the findings of (33), who reported an increase in niacin content in cereal porridge fortified with mushroom flour. The addition of *L. togolana* stem powder led to an increase in the vitamin B6 (pyridoxine) content of the instant *Ogi*. Sample LIO3 had the highest concentration (0.41 ± 0.01 mg/100g), significantly higher than the control (IOF) sample, which contained 0.32 ± 0.00 mg/100g. This indicates that *L. togolana* stem powder enhances pyridoxine levels in the fortified *Ogi*.

The results demonstrated a notable increase

Table 3. Vitamins concentrations of enriched instant *Ogi* with *L. togolana* stem powder

Vitamin (mg/100g)	IOF	LIO1	LIO2	LIO3
B1	0.38 ± 0.00^{a}	0.39 ± 0.00^{a}	0.40 ± 0.00^{a}	0.47 ± 0.01^{ab}
B2	0.15 ± 0.00^{a}	0.15 ± 0.00^{a}	0.17 ± 0.00^{ab}	0.22 ± 0.01^{b}
B3	2.69 ± 0.00^{a}	2.70 ± 0.00^{a}	2.80 ± 0.00^{a}	2.88 ± 0.00^{a}
B6	0.32 ± 0.00^{a}	0.34 ± 0.00^{a}	0.37 ± 0.00^{ab}	0.41 ± 0.01^{b}
B9	8.22 ± 0.02^{a}	8.31 ± 0.00^{a}	8.90 ± 0.01^{b}	9.37 ± 0.06^{c}
C	0.83 ± 0.00^{a}	1.43 ± 0.00^{b}	1.83 ± 0.00^{c}	1.96 ± 0.05^{c}
E	1.54 ± 0.01^{a}	1.64 ± 0.01^{b}	1.67 ± 0.01^{c}	1.78 ± 0.01^{d}

Key: **IOF =** 100% Instant *Ogi* flour; **LIO1**: 95% instant *Ogi* flour and 5% *Landolphia togolana* stem powder; **LIO2**: 90% instant *Ogi* flour and 10% *Landolphia togolana* stem powder and **LIO3**: 85% instant *Ogi* flour and 15% *Landolphia togolana* stem powder.

Note: *Values are presented as Mean ± SD (Standard Deviation), n = 2. Values with different superscripts within the same row are significantly different at (p<0.05).*

in vitamin B9 (folate) concentration with the addition of *L. togolana* stem powder. Sample LIO3 exhibited the highest ($p<0.05$) concentration (9.37 ± 0.06 mg/100g), significantly surpassing the control (IOF) sample (8.22 ± 0.02 mg/100g). This indicates that *L. togolana* stem powder could serve as a potent source of folate in instant *Ogi*. Notably, vitamin C (ascorbic acid) concentrations in the enriched *Ogi* formulations (LIO1, LIO2, and LIO3) were substantially higher ($p<0.05$) compared to the control (IOF). LIO3 displayed the highest concentration of 1.96 ± 0.05 mg/100g, indicating that *L. togolana* stem powder significantly enhanced the vitamin C (ascorbic acid) content. This is also similar to the study of (32). The vitamin E (tocopherol) concentrations in the enriched *Ogi* formulations were consistently higher than in the control (IOF), with LIO3 showing the highest concentration of 1.78 ± 0.01 mg/100g. The results suggest that *L. togolana* stem powder positively influenced the vitamin E content in the instant *Ogi*.

Minerals Content Determination

Table 4 revealed the impact of incorporating different proportions of *L. togolana* stem powder on the mineral content of instant *Ogi*. As the percentage of the stem powder increases (from LIO1 to LIO3), there is a noticeable increase in the concentration of Zn, Fe, Ca, P, and K. This suggests that *L. togolana* stem powder is a valuable source of essential minerals that can significantly enhance the nutritional profile of instant *Ogi*. The results indicate a gradual increase in zinc concentration by incorporating *L. togolana* stem powder. IOF (100% Instant *Ogi* flour) exhibited the lowest zinc content at 2.84 mg/100g, while LIO3 (85% Instant *Ogi* flour and 15% *L. togolana* stem powder) showed the highest zinc concentration at 4.06 mg/100g. The differences in zinc levels are statistically significant ($p<0.05$), suggesting that *L. togolana* stem powder supplementation positively influences zinc content in instant *Ogi*. This is in agreement with the study of (34) that enriched Sorghum-*Ogi* with cocoa powder. Their results indicated a notable ($p<0.05$) increase in the formulations with cocoa powder. Like zinc, the iron content increased as *L. togolana* stem powder was added. IOF had the lowest iron concentration at 4.46 mg/100g, while LIO3 had the highest at 5.96 mg/100g. The differences observed are statistically significant ($p<0.05$), signifying the potential of *L. togolana* stem powder to enhance iron levels in instant *Ogi*. This is similar to the work of (5), who enriched powdered *Ogi* with date palm fruits to improve its nutritional composition of *Ogi*.

Calcium concentration showed slight variations across the different formulations of enriched instant *Ogi*. The calcium content ranged from 28.40 mg/100g in IOF to 30.92 mg/100g in LIO3. However, the differences were slightly significant ($p<0.05$), indicating that adding *L. togolana* stem powder barely affected the calcium levels in the final product. This is similar to the research carried out by (35) that enriched yellow maize *Ogi* porridge enriched with African Yellow Bean (AYF) flour which shows a significant ($p<0.05$) increase in the amount of calcium of the *Ogi*. Phosphorus content gradually increased with the addition of *Landolphia togolana* stem powder. IOF had the lowest phosphorus content at 286.50 mg/100g, whereas LIO3 showed the highest at 298.47 mg/100g. The observed differences in phosphorus levels were statistically significant ($p<0.05$), highlighting the positive impact of *Landolphia togolana* stem powder on phosphorus enrichment in instant *Ogi*. This is also similar to the work of (5), who enriched powdered *Ogi* with date palm fruits to improve its nutritional composition of *Ogi*. Potassium content also consistently increased as the proportion of *Landolphia togolana* stem powder increased. IOF had the lowest potassium concentration at 351.91 mg/100g, while LIO3 had the highest at 365.65 mg/100g. The differences in potassium levels were statistically significant ($p<0.05$), suggesting that adding *Landolphia togolana* stem powder positively influenced potassium levels in instant *Ogi*. This is also in line with the work of (5), who enriched powdered *Ogi* with date palm fruits to improve its nutritional composition of *Ogi*.

Sensory Analysis Result

The results presented in Table 5 show the mean scores and standard deviations for sensory evaluation attributes of instant *Ogi* enriched with different proportions of *L. togolana* stem

powder. The sensory evaluation assessed the *Ogi* samples' color, aroma, texture, taste, and overall acceptability. The color attribute received the highest mean score in all samples, ranging from 7.05 to 7.99. The mean score of IOF was significantly higher ($p < 0.05$) than that of LIO2 and LIO3, suggesting that the addition of *L. togolana* stem powder at higher proportions (10% and 15%) resulted in a slight reduction in the perceived color appeal compared to the control sample (IOF). However, all samples still received relatively high scores, indicating that adding *L. togolana* stem powder did not significantly affect the color perception of the *Ogi*.

The aroma attribute showed a variation in mean scores among the samples, ranging from 7.18 to 7.73. LIO1 obtained the highest mean score for aroma, significantly different ($p < 0.05$) from the aroma mean scores of LIO2 and LIO3. The aroma scores for IOF and LIO1 were relatively close, suggesting that adding a 5% proportion of *L. togolana* stem powder did not negatively impact the aroma perception of the *Ogi*. For the texture attribute, the mean scores ranged from 6.95 to 8.16. IOF received the highest mean score for texture, which was significantly different ($p < 0.05$) from the scores of LIO2 and LIO3. This indicates that the incorporation of 10% and 15% *L. togolana* stem powder negatively affected the texture perception of the *Ogi*. However, the difference between IOF and LIO1 was insignificant; suggesting that adding 5% *L. togolana* stem powder had a minor effect on the texture.

The taste attribute significantly varied among the samples, with mean scores ranging from 7.33 to 7.82. The taste mean score of IOF was lower ($p < 0.05$) than that of LIO1; indicating that adding 5% *L. togolana* stem powder improved the taste perception of the *Ogi*. However, the taste scores of IOF and LIO2 were not significantly different; suggesting that further increasing the proportion of *L. togolana* stem powder (10% and 15%) did not lead to further improvements in taste. The participants' overall acceptability scores of the *Ogi* samples ranged from 7.40 to 8.15. The control (IOF) obtained the highest mean overall acceptability score, which was significantly

Table 4. The mineral concentration of enriched instant *Ogi* with *L. togolana* stem powder

Minerals (mg/100g)	IOF	LIO1	LIO2	LIO3
Zn	2.84 ± 0.07^{a}	2.91 ± 0.03^{a}	3.13 ± 0.02^{ab}	4.06 ± 0.11^{b}
Fe	4.46 ± 0.00^{a}	4.57 ± 0.03^{a}	4.96 ± 0.04^{b}	5.96 ± 0.20^{c}
Ca	28.40 ± 0.58^{a}	29.80 ± 0.10^{a}	30.43 ± 0.79^{b}	30.92 ± 0.19^{b}
P	286.50 ± 0.88^{a}	290.52 ± 2.35^{b}	296.07 ± 1.12^{c}	298.47 ± 1.34^{d}
K	351.91 ± 1.56^{a}	357.22 ± 1.40^{b}	360.72 ± 0.69^{c}	365.65 ± 0.52^{d}

Key: **IOF =** 100% Instant *Ogi* flour; **LIO1**: 95% instant *Ogi* flour and 5% *Landolphia togolana* stem powder; **LIO2**: 90% instant *Ogi* flour and 10% *Landolphia togolana* stem powder and **LIO3**: 85% instant *Ogi* flour and 15% *Landolphia togolana* stem powder.

Note: *Values are presented as Mean ± SD (Standard Deviation), n = 2. Values with different superscripts within the same row are significantly different at (p<0.05).*

Table 5. Mean ($\bar{x}$) and Standard Deviation (SD) of Sensory Evaluation of Instant *Ogi* enriched with *L. togolana* Stem Powder

Sample	Color	Aroma	Texture	Taste	Overall Acceptability
IOF	7.99 ± 0.75^{a}	7.20 ± 1.08^{ab}	8.16 ± 1.09^{a}	7.58 ± 0.98^{b}	8.15 ± 0.79^{a}
LIO1	7.55 ± 0.98^{ab}	7.73 ± 1.17^{a}	7.91 ± 1.08^{ab}	7.82 ± 0.99^{a}	8.02 ± 0.82^{ab}
LIO2	7.15 ± 1.02^{abc}	7.18 ± 1.19^{b}	7.36 ± 1.45^{abc}	7.58 ± 1.22^{b}	7.63 ± 1.12^{abc}
LIO3	7.05 ± 1.08^{bc}	7.18 ± 1.38^{b}	6.95 ± 1.21^{bc}	7.33 ± 1.27^{c}	7.40 ± 1.21^{abc}

Key: **IOF =** 100% Instant *Ogi* flour; **LIO1**: 95% instant *Ogi* flour and 5% *Landolphia togolana* stem powder; **LIO2**: 90% instant *Ogi* flour and 10% *Landolphia togolana* stem powder and **LIO3**: 85% instant *Ogi* flour and 15% *Landolphia togolana* stem powder.

different ($p < 0.05$) from the scores of LIO2 and LIO3. This suggests that the incorporation of 10% and 15% *L. togolana* stem powder significantly influences the overall acceptability of the *Ogi*. This is consistent with the findings of (36), who supplemented *Ogi* with termite flour and revealed that the modified *Ogi* maintained higher overall acceptability compared to traditional *Ogi*. However, the overall acceptability score of LIO1 was not quite different ($p>0.05$) from that of IOF, indicating that adding 5% *L. togolana* stem powder maintained the overall acceptability of the *Ogi*.

CONCLUSIONS

In conclusion, the research highlights the significance of consuming enriched instant *Ogi* with *L. togolana* and its widespread popularity. The sensory evaluation suggests that incorporating 5% stem powder maintains acceptability. Low awareness about the product's benefits and nutritional advantages could hinder its adoption. Factors influencing acceptability and barriers to adoption should be considered when promoting this enriched *Ogi*. The study also provides valuable insights into the nutritional changes of adding *L. togolana* stem powder. It was highlighted that the higher the level of *L. togolana* in the *Ogi* sample, the higher the nutrient present. Further awareness campaigns and education programs are recommended to enhance acceptance and adoption. The nutritional values of enriched *Ogi* with *L. togolana* stem powder in this study could help meet the dietary needs of various groups, thus increasing the popularity and usage of the plant.

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ENDIX

Plate 1. *Sorghum* Flour

Plate 2. *L. togolana stem powder*

Plate 3. Packaged LTSP *Ogi (instant Ogi)*.

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Research Article / Araştırma Makalesi

Refugee Gastronomy and Sustainable Development: The Case of Gaziantep

Mülteci Gastronomisi ve Sürdürülebilir Kalkınma: Gaziantep Örneği

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Abstract

Objective: This study investigates the relationship between refugee gastronomy and sustainable development, focusing specifically on Syrian-owned food enterprises in Gaziantep, Turkey. It aims to understand how refugee-led culinary practices contribute to economic participation, cultural sustainability, social inclusion, and urban resilience within host communities.

Method: The research draws on key sociological concepts—such as Bourdieu's *cultural capital*, Bhabha's *hybridity*, and Appadurai's *gastro-politics*—to develop a conceptual framework. Quantitative data were collected on 975 Syrian-owned businesses in Gaziantep, of which 203 operate in food-related sectors, including restaurants, bakeries, and cafes.

Results: The findings reveal that refugee-led culinary initiatives promote cross-cultural interaction, create employment opportunities, and strengthen community ties. These enterprises often facilitate gender-inclusive entrepreneurship and the preservation of culturally embedded food practices. The integration of refugee cuisine into local foodscapes also contributes to mutual understanding and community cohesion.

Conclusion: The study demonstrates that gastronomy functions not only as a site of cultural expression but also as a strategic vector for integration and sustainability. By aligning these practices with Sustainable Development Goals 8 (Decent Work and Economic Growth), 10 (Reduced Inequalities), 11 (Sustainable Cities and Communities), and 12 (Responsible Consumption and

Production), the research highlights the transformative potential of food in fostering inclusive economic development and multicultural urban integration. The Gaziantep case illustrates how refugee gastronomy can enrich both local economies and social fabrics, offering a replicable model for other urban contexts.

Özet

Amaç: Bu çalışma, mülteci gastronomisi ile sürdürülebilir kalkınma arasındaki ilişkiyi araştırmakta ve özellikle Gaziantep'teki Suriyeli mültecilere ait gıda işletmelerine odaklanmaktadır. Araştırmanın amacı, mülteci öncülüğünde yürütülen mutfak pratiklerinin ev sahibi toplumlarda ekonomik katılım, kültürel sürdürülebilirlik, sosyal kapsayıcılık ve kentsel dayanıklılığa nasıl katkı sağladığını anlamaktır.

Yöntem: Araştırma, Bourdieu'nün kültürel sermaye, Bhabha'nın melezlik ve Appadurai'nin gastro-politika kavramları gibi temel sosyolojik yaklaşımlardan yararlanarak kavramsal bir çerçeve geliştirmiştir. Gaziantep'te 975 Suriyeli mülteciye ait işletmeye ilişkin nicel veriler toplanmış, bunlardan 203'ünün restoran, pastane ve kafe gibi gıda sektörlerinde faaliyet gösterdiği belirlenmiştir.

Bulgular: Elde edilen bulgular, mülteci öncülüğündeki gastronomi girişimlerinin kültürlerarası etkileşimi teşvik ettiğini, istihdam yarattığını ve toplumsal bağları güçlendirdiğini göstermektedir. Bu işletmeler, toplumsal cinsiyete duyarlı girişimciliği desteklemekte ve kültürel olarak köklü gıda pratiklerinin korunmasına katkıda bulunmaktadır. Mülteci mutfaklarının yerel gastronomiyle bütünleşmesi, karşılıklı anlayışı artırmakta ve toplumsal uyumu pekiştirmektedir.

Sonuç: Bu çalışma, gastronominin yalnızca kültürel bir ifade biçimi değil, aynı zamanda toplumsal uyum ve sürdürülebilirlik için stratejik bir araç olduğunu ortaya koymaktadır. Bu uygulamaların Sürdürülebilir Kalkınma Amaçları olan (İnsana Yakışır İş ve Ekonomik Büyüme 8), (Eşitsizliklerin Azaltılması 10), (Sürdürülebilir Şehirler ve Topluluklar 11) ve (Sorumlu Tüketim ve Üretim 12) ile örtüştüğü görülmektedir. Gaziantep örneği, mülteci gastronomisinin hem yerel ekonomiyi hem de toplumsal dokuyu zenginleştirme potansiyeline sahip olduğunu ve bu modelin diğer kentsel bağlamlarda da uygulanabilir olduğunu göstermektedir.

INTRODUCTION

The global refugee population has surged to 120 million due to wars, population growth, famine and economic instability. Over the last year, the number of refugees increased by 8.8%, with real figures likely surpassing official estimates. As it is anticipated that many societies will face similar migration challenges in the future, the integration of refugees into settled communities has become an essential issue. Approximately 80% of refugees are unable to return to their home countries, making their integration into host societies imperative. Throughout history, successful and developed societies have capitalized on the human and cultural resources brought by refugees, fostering rapid development.

Gastronomy emerges as a powerful tool in this integration process, transcending cultural barriers and building bridges between refugees and local communities. As a deeply cultural practice, it offers a platform for everyday encounters between refugees and host communities. This interaction can be examined through Pierre Bourdieu's concept of cultural capital (1), which highlights the value of embodied knowledge—such as culinary skills—as a resource that individuals can mobilize to gain recognition and inclusion. Refugees bring with them not only ingredients and recipes but also culinary techniques, rituals, and symbolic meanings associated with food. These resources contribute to the enrichment of local gastronomic landscapes and create pathways for social participation. Drawing on Bourdieu's notion of embodied cultural capital, culinary knowledge carried by refugees—often acquired through family, tradition, and practice—functions as a social resource that facilitates their participation and visibility in host societies. Through the culinary traditions they bring, refugees not only preserve their cultural identity but also contribute to the sustainability of this heritage within their new societies. This interaction fosters cultural and social sustainability by creating opportunities for social integration through shared culinary experiences.

Interactions and exchanges in gastronomy and

food techniques between refugees and local people can have significant cultural, social and economic benefits. Here are some ways in which these interactions can take place; i) Cultural exchange: Gastronomy is deeply rooted in culture and traditions. When refugees and local people come together to share their culinary knowledge and techniques, it creates an opportunity for cultural exchange. Refugees can introduce their traditional dishes, flavors and cooking methods, while locals can share their own culinary heritage. This exchange promotes understanding, appreciation and respect for different cultures; ii) Skill sharing: Refugees often bring unique culinary skills and techniques from their home countries. By sharing these skills with local communities, they can contribute to the local food scene and provide an opportunity for locals to learn new cooking techniques, ingredients and flavors. This exchange of culinary knowledge can enrich the local culinary landscape and provide economic opportunities for both refugees and locals; iii) Community integration: Food has a way of bringing people together. Collaborative cooking activities or community events that involve refugees and locals can foster social integration and create a sense of belonging. Through these interactions, refugees and locals can form meaningful connections, break down cultural barriers and build supportive networks; iv) Economic empowerment: Refugee communities often face economic challenges when they first arrive in a new country. By sharing their culinary skills and traditional cuisines, refugees can create opportunities for entrepreneurship and economic empowerment. This can be achieved through starting food businesses, participating in farmers' markets or food festivals, or even offering cooking classes to the local community. These initiatives can help refugees gain financial independence and contribute to the local economy; v) Culinary fusion: When refugees and locals interact in the realm of gastronomy, it often leads to culinary fusion, where traditional dishes from different cultures blend together to create unique and exciting flavors. This fusion cuisine not only reflects the diversity of the community but also creates new culinary experiences that can be appreciated by all.

Such exchanges also generate hybrid culinary forms, reflecting Homi Bhabha's notion of hybridity (2), where elements of refugee and host cuisines merge to form new, culturally layered practices. As Homi Bhabha suggests, hybridity emerges in spaces of cultural encounter, producing new meanings that destabilize binary notions of self and other. Refugee cuisine exemplifies this, as local and migrant culinary elements fuse to create hybrid forms of cultural expression. The blending of ingredients, preparation methods, and consumption styles results in culinary expressions that go beyond binary distinctions of "local" and "foreign." This process of hybridization not only expands culinary diversity but also serves as a metaphor for the negotiation of belonging, identity, and cultural transformation.

At the same time, food functions as a space of negotiation and symbolic power, as described in Arjun Appadurai's concept of gastro-politics (3). The act of cooking, sharing, and consuming food involves more than sustenance—it is embedded in questions of visibility, agency, and inclusion. Refugees who engage in gastronomy-based entrepreneurship—such as running restaurants, food stalls, or catering services—actively participate in shaping public tastes, narratives, and perceptions, thereby contributing to the sociocultural fabric of their host environments.

Recent empirical examples illustrate the multifaceted role of gastronomy in integration dynamics. In Germany, the widespread adoption of döner kebab—originally introduced by Turkish migrants and popularized further by refugee entrepreneurship—demonstrates how food can transform from a cultural marker of difference to a symbol of national identity. Similarly, in Turkey, the arrival of Syrian refugees has significantly influenced the local food scene. Syrian-owned cafés, sweet shops, bakeries, and restaurants have become part of everyday urban life, especially in cities like Gaziantep and Istanbul. These establishments offer more than culinary products; they serve as social spaces where interaction, recognition, and exchange take place.

Notably, this process is not confined to

private initiatives. Governmental and non-governmental actors, including NGOs and international agencies, have recognized the integrative potential of gastronomy. In Turkey, organizations such as the Foundation for the Support of Women's Work (KEDV) have been instrumental in facilitating refugee women's participation in the food economy (4). KEDV has supported the formation of multi-ethnic women's cooperatives in cities like Gaziantep and Istanbul, where Syrian and Turkish women work together to produce and sell traditional food products. These cooperatives offer not only income-generating opportunities, but also spaces of solidarity and social inclusion, where women share stories, culinary knowledge, and emotional support. Through training programs, access to commercial kitchens, and support for branding and marketing, KEDV helps women move from informal labor to formal entrepreneurship. Projects involving intercultural cooking workshops, community kitchens, and refugee-led food cooperatives exemplify how food can be utilized as a deliberate tool for social cohesion and empowerment. Such efforts also align with broader frameworks such as the Sustainable Development Goals, particularly in promoting decent work, reducing inequalities, and fostering inclusive communities. Additionally, providing access to commercial kitchens, mentorship programs and business development support can help refugees turn their culinary skills into sustainable livelihoods.

In this context, the United Nations Sustainable Development Goals (SDGs) offer a globally recognized framework for understanding and addressing interconnected challenges related to poverty, inequality, environmental degradation, and social inclusion. As a universal agenda adopted by 193 UN member states, the SDGs not only set measurable targets but also emphasize the need for integrated and inclusive approaches that transcend disciplinary and sectoral boundaries. This study engages with the SDGs not as an external add-on, but as a meaningful analytical lens through which to examine how refugee-led food practices contribute to sustainable urban life, economic empowerment, and cultural resilience. In particular, the research aligns with SDG 8 (Decent Work and Economic Growth), SDG 10 (Reduced Inequalities), SDG 11 (Sustainable Cities and Communities), and SDG 12 (Responsible Consumption and Production), all of which intersect in the everyday spaces where food is produced, shared, and consumed.

Overall, interactions and exchanges in gastronomy and food techniques between refugees and local people have the potential to foster cultural understanding, social integration, economic empowerment and culinary innovation. By embracing diversity and celebrating the richness of different food traditions, communities can create a more inclusive and vibrant gastronomic landscape.

In sum, refugee gastronomy operates at the intersection of culture, economy, and politics. It not only facilitates cultural sustainability and mutual understanding but also offers tangible opportunities for participation, resilience, and shared growth. When supported by inclusive policies and community engagement, it becomes a medium through which integration is lived, experienced, and continually redefined.

This study aims to investigate how refugee-led culinary practices—particularly those shaped by the Syrian community in Turkey—contribute to social integration and cultural sustainability in host societies. In doing so, it situates food not only as a medium of survival or heritage but also as a transformative tool within the framework of the United Nations Sustainable Development Goals (SDGs). Specifically, this research highlights the intersections between refugee gastronomy and SDG 8 (Decent Work and Economic Growth), SDG 10 (Reduced Inequalities), SDG 11 (Sustainable Cities and Communities), and SDG 12 (Responsible Consumption and Production). By analyzing empirical cases and drawing on cultural theory, the paper explores how food-related practices open up spaces for recognition, participation, and sustainable development in increasingly diverse urban environments.

Theoretical Framework

Food plays a pivotal role in the processes of adaptation and integration for refugees, functioning as both a marker of human identity

and a vehicle of cultural expression (5). Culinary practices enable displaced individuals not only to maintain a sense of continuity with their homeland but also to construct new forms of belonging in their host societies. As migrants and refugees navigate new environments, their dietary habits often undergo modification due to changes in availability, affordability, or cultural expectations. This process—frequently involving altered preparation techniques and the substitution of ingredients—is more than a matter of nutrition; it reflects deeper negotiations of identity and cultural continuity (6).

These culinary shifts often give rise to what Abbots (7) describes as hybridization—a blending of migrant and host food cultures. Migrant dishes are no longer consumed in isolation but are served alongside, or fused with, local meals. This culinary interweaving illustrates Homi Bhabha's concept of cultural hybridity, wherein cultural boundaries become porous and new, shared identities emerge. The exchange of culinary skills and tastes is not a one-way process of assimilation but a dynamic interaction that can enrich both communities.

Furthermore, food functions as a platform for building social capital, as explored in the work of Long and Ager (8). Their research underscores the capacity of food-centered interactions to create networks of trust, reciprocity, and mutual recognition between refugees, migrants, and host populations. These everyday encounters—whether through shared meals, food festivals, or local market exchanges—contribute to social cohesion and collective resilience.

In the context of the United States, Hayes-Conroy and Hayes-Conroy (9) emphasize how gastronomic practices serve as a medium through which refugees establish social connections and adapt to unfamiliar cultural landscapes. Through the preparation and sharing of food, refugees assert cultural agency and participate in the co-creation of community. Likewise, Carballo-Cruz and Saenz De Jubera (10), in their study of Spain, demonstrate that gastronomy can operate as a deliberate tool of integration, fostering cross-cultural understanding and challenging stereotypes through interpersonal exchange.

Together, these studies demonstrate that refugee gastronomy is not simply about food—it is about recognition, participation, and transformation. Culinary practices enable refugees to assert their presence in society, negotiate belonging, and contribute to a shared cultural future. These dynamics resonate closely with Pierre Bourdieu's theory of cultural capital (1), as refugees draw upon culinary knowledge not only for survival but also for social mobility, visibility, and symbolic integration into their new environments.

The role of food in social integration can be analyzed through various theoretical lenses. One such framework is Pierre Bourdieu's concept of cultural capital (1), which posits that cultural knowledge, including culinary skills, can be a form of social currency that helps individuals navigate and integrate into new social environments. For refugees, their culinary traditions represent a significant form of cultural capital that can be leveraged to gain acceptance and establish connections within their host communities. This concept of capital refers to non-economic forms of capital—such as knowledge, skills, education, and cultural habits—that enable individuals to navigate and gain recognition in social spaces. In the context of refugee integration, culinary knowledge and gastronomic practices can be understood as forms of embodied cultural capital. Refugees carry with them a repertoire of culinary techniques, ingredients, recipes, and food-related rituals, which may serve not only as sources of personal identity but also as tools for building social relationships in the host society. Through food preparation, presentation, and consumption, refugees make their cultural capital visible and potentially exchangeable, contributing to their symbolic and practical integration.

This perspective frames food as more than sustenance; it becomes a medium of social positioning, community participation, and economic opportunity. Refugee-led culinary enterprises—such as restaurants, bakeries, or catering businesses—demonstrate how cultural capital can be mobilized in new settings to foster inclusion, economic empowerment, and intercultural dialogue.

Another relevant theory is Homi K. Bhabha's concept of hybridity (2), which describes the process by which immigrant cultures blend with local cultures to create new, hybrid identities. In the context of refugee gastronomy, hybridity is evident in the fusion cuisines that emerge when traditional refugee dishes are adapted to incorporate local ingredients and tastes. This process not only enriches the culinary landscape but also symbolizes the blending of cultural identities, facilitating social integration and mutual understanding. Homi K. Bhabha's theory of hybridity highlights how cultural identities are not fixed but are constantly negotiated and redefined through contact and interaction. In the case of refugee gastronomy, hybridity is often observed in the creation of fusion cuisines—where traditional dishes are adapted using local ingredients or cooking methods, resulting in new culinary forms that blend elements of both migrant and host cultures.

These hybrid dishes are not merely gastronomic inventions; they reflect deeper processes of identity negotiation, cultural adaptation, and mutual influence. They serve as everyday representations of cultural coexistence and can help soften social boundaries by offering familiar yet novel food experiences to locals. Hybridity, in this sense, facilitates cultural recognition and reduces the perceived "otherness" of refugee communities.

Arjun Appadurai's notion of "gastro-politics" further expands the discussion by emphasizing how food can serve as a site of political and social negotiation (3). In line with Arjun Appadurai's concept of gastro-politics, food is not merely sustenance but a medium through which power, identity, and belonging are contested and negotiated—especially for marginalized populations like refugees. In refugee contexts, the act of sharing and consuming food becomes a form of dialogue, where power dynamics, cultural values and social boundaries are negotiated and potentially redefined. Arjun Appadurai's concept of gastro-politics considers food as a site where social relations, power dynamics, and cultural values are actively negotiated. In contexts of migration and displacement, food becomes a medium through which refugees assert agency, articulate identity, and engage in symbolic and material negotiations with the host society.

Gastro-politics highlights the political dimension of food: who cooks, who serves, who eats, and under what conditions. When refugees establish food businesses or participate in food-related events, they are not only feeding people but also shaping public perceptions, challenging stereotypes, and asserting their place within the cultural and economic life of the host society. Culinary practices thus become acts of both survival and resistance, shaping the everyday politics of belonging.

The Role of Food in Adaptation and Integration

As mentioned previously, there is a strong link between human identity and culture due to critical role of food in the adaptation and integration of refugees (5). As refugees adapt to their new environments, their culinary practices evolve, blending their traditional techniques with local influences (6). This fusion results in hybridized culinary practices that reflect both migrant and host cultures, enriching the local food landscape and creating new gastronomic experiences (7).

The culinary contributions of refugees, exemplified by baklava shops and döner vendors, expand the diversity of local cuisine while promoting social interaction and cultural understanding. An emerging symbol of multicultural refugee cuisine could be "hummus," a notable dish increasingly used as a vehicle for integration. These businesses serve as platforms for cultural exchange, where locals and refugees share and learn from each other's culinary heritage, thereby fostering mutual respect and appreciation (8). Gastronomical businesses such as baklava and döner shops established by refugees expand the local culinary landscape, enhance diversity, promote social interaction and deepen cultural understanding. These interactions not only enrich the existing social fabric but also play a crucial role in building a sustainable future. The contributions of refugees in the field of gastronomy significantly

bolster local economies, increase employment and help establish peaceful relations between different communities.

In the modern landscape of global migration, food plays a pivotal role in cultural integration and identity formation. One of the most striking examples of refugee gastronomic influence can be observed in Germany, where döner kebabs have become a staple of the local diet. Introduced by Turkish immigrants, many of whom were refugees or guest workers, döner shops have proliferated across Germany, to the point where they have become an integral part of German street food culture. The widespread popularity of döner kebabs highlights the successful integration of Turkish refugees into German society, demonstrating how food can serve as a bridge between cultures. The presence of these shops has not only enriched the German culinary landscape but has also facilitated social interactions between Germans and the Turkish community, fostering a sense of inclusivity and shared cultural space. Immigrant food businesses, such as döner shops in Germany and baklava shops worldwide, exemplify the dynamic interaction between cultures. These establishments not only offer culinary delights but also serve as platforms for social exchange, fostering mutual understanding and respect. The döner kebab, a staple of Turkish cuisine, found its way to Germany in the 1970s with the influx of Turkish guest workers. Initially a quick, affordable meal for workers, it quickly gained popularity among locals. Döner shops have become ubiquitous in Germany, representing more than just a meal. They are symbols of multiculturalism and integration, reflecting the blending of Turkish and German cultures. The adaptation of the döner to suit local tastes-such as adding different sauces or ingredients-demonstrates culinary hybridity. The döner industry has also significantly contributed to the German economy, providing employment and stimulating local businesses. These shops often serve as entry points for immigrants, offering opportunities for entrepreneurship and economic advancement. Today, the German people have embraced döner so much that it has become recognized as a German dish. During his visit to Turkey in 2024, German President Steinmeier (11) emphasized the ties between the people of the two countries through döner, which is important to understand how influential migrant gastronomy is. Döner diplomacy was so prominent that the German president invited Arif Keleş, a döner master from Berlin whose grandfather had migrated to Germany as a laborer in the 1960s, to join his delegation during his visit to Turkey. This type of kebab, has become a frequently eaten German dish in Germany. For this purpose, German President Frank Walter Steinmeier hosted a reception during his visit to Istanbul and said, "Döner kebab has now become the national dish of Germany." At the residence, Steinmeier cut döner kebab with Arif Keleş, a third-generation döner kebab maker who runs a döner shop in Berlin. Steinmeier (11) said, "No fast-food is sold more, eaten more or even exported more than döner kebab in Germany. It should be noted as an interesting note in history that this is similar to the situation a century ago, when workers migrating from Hamburg to America carried the hamburger to America and introduced it to the whole of America. Similar to döner kebab, shawarma is the most prominent of the many products that Lebanese and Syrian refugees have brought to western culture. One of the most important examples of the fast-food sector produced with a technique similar to döner, this döner of the Arab culture has also provided a cultural transfer in all the countries it has traveled to, and as a result, it has also enabled the establishment of bridges between the local people and the refugees.

Similarly, baklava shops established by Middle Eastern refugees have spread across the globe, from the United States to Australia. These shops often serve as cultural hubs where the culinary traditions of the refugees are celebrated and shared with local communities. In the United States, for example, baklava has become a popular dessert, embraced by a diverse range of cultural groups. The integration of baklava into the American dessert repertoire exemplifies how refugee cuisines can be assimilated into the broader food culture of a host country, contributing to cultural diversity and social cohesion. Baklava is a traditional dessert

produced and highly enjoyed in countries like Turkey, Syria, and Lebanon. With refugees and immigrants, baklava has spread to other countries. It became known in America, especially with Armenians who migrated to California. Later, baklava was brought to Europe by Turkish and Arab immigrants. Today, baklava has become a global dessert. Baklava has the potential to foster positive dialogues between cultures as it is often given as a gift and triggers happiness hormones when consumed. Therefore, sweet and pleasant foods like baklava facilitate the establishment of cultural bridges between locals and refugees.

The global diffusion of immigrant culinary practices, such as baklava, mirrors the journeys of those who carry their gastronomic heritage across borders. Often associated with hospitality and celebration, baklava is traditionally served at weddings, religious festivals, and family gatherings, symbolizing warmth, generosity, and shared identity. As baklava shops open in diverse cultural settings—from the United States to Europe and Australia—the dessert adapts to local palates, giving rise to regional variations that reflect both the adaptability and resilience of migrant traditions. These immigrant-owned food establishments frequently evolve into community hubs, facilitating everyday interactions between locals and newcomers, fostering curiosity, and breaking down cultural barriers. In this context, Pierre Bourdieu's concept of cultural capital, particularly in its embodied form, offers a valuable framework for understanding how such culinary practices enable processes of social inclusion. Unlike institutionalized capital such as formal education, embodied cultural capital consists of deeply internalized dispositions—culinary skills, taste preferences, and food-related rituals—acquired through lived experience. Refugees and immigrants mobilize this capital through performative acts such as cooking, serving, and sharing food in new social settings. These practices not only contribute to the richness of the local gastronomic landscape but also serve as strategies for recognition and legitimacy in the host society. Thus, through gastronomy, refugee communities engage in cultural exchange while actively participating in shaping inclusive and pluralistic foodscapes.

In a contemporary context, the cuisine of Syrian refugees has significantly influenced Turkish gastronomy both economically and culturally. Syrian individuals have established a substantial number of cafés, patisseries, bakeries, fast-food outlets, and restaurants, introducing their culinary traditions into the Turkish food landscape. By adapting their recipes to align with the local palate and by introducing new consumption practices, they have facilitated both gastronomic exchange and social interaction.

These food-related enterprises are not merely commercial establishments; they function as cultural bridges that foster interaction between diverse communities. Through sharing the tastes of their homeland, refugee entrepreneurs contribute to the cultural mosaic of their host country, encouraging mutual respect and intercultural understanding.

Beyond individual initiatives, both governmental and non-governmental actors have recognized the integrative potential of food and gastronomy. Numerous projects initiated by NGOs and international organizations have strategically used cuisine as a tool for social inclusion and cohesion, especially within refugee-host community dynamics.

These processes of gastronomic adaptation and integration are particularly visible in Turkey. In metropolitan areas such as Istanbul, the Aksaray district has emerged as a gastronomic enclave known as "Little Damascus," where a dense concentration of Syrian restaurants, sweet shops, and cafés has cultivated a tangible environment of cultural hybridity. These venues attract not only the Syrian diaspora but also local Turkish residents and international visitors, facilitating everyday cultural exchange.

A similar pattern is observable in Gaziantep, where Syrian-owned eateries such as *Sultana* and *Aleppo Kitchen, Istasyon* have become integral to the local culinary scene. Offering dishes such as *kibbeh*, *kebab halabi*, and *lahma bil karaz*, these restaurants demonstrate how Syrian culinary heritage blends with regional Turkish tastes, fostering both daily social interaction and longer-term intercultural dialogue. Additionally,

innovative initiatives such as *Mutfakna*—a vegan restaurant whose name combines the Turkish word *mutfak* (kitchen) and the Arabic suffix *-na* (our)—symbolize culinary cohesion and solidarity between Syrian and Turkish communities, reflecting the potential of shared food practices to build inclusive cultural spaces.

Moreover, the widespread popularization of items like *coffee with cardamom*, *falafel*, *hummus*, and *Sham-style döner (Shawarnma)*—distinguished by its garlic sauce, sumac-seasoned onions, and pickled vegetables wrapped in *lavash*—within Turkey's fast food and street food scenes exemplifies deeper gastronomic integration. Even national chains such as *Komagene* have incorporated falafel into their menus, signaling the mainstreaming of such hybrid culinary forms.

These examples illustrate how food operates as a mediator of identity, belonging, and cultural negotiation in migratory contexts. Through everyday practices of cooking, sharing, and consuming food, refugees not only preserve their cultural heritage but also actively participate in shaping an inclusive and evolving foodscape in their host societies.

Methodology

This study employs a quantitative case study design complemented by qualitative interpretation to explore the economic and cultural contributions of refugee-led food businesses, with a particular focus on Syrian-owned enterprises in Gaziantep, Turkey. While no primary qualitative data (e.g., interviews or ethnographic fieldwork) were collected, the analysis is informed by a theory-guided interpretation of quantitative data, a well-established approach in sociological and cultural research (23) (24).

The research draws on firm-level secondary data obtained in October 2024 from the available records on the Turkish Trade Registry Gazette [Türkiye Ticaret Sicil Gazetesi], accessed via its official online platform (22). In total, 975 Syrian-owned businesses legally registered in Gaziantep were identified.

Using NACE classification codes, these firms were categorized by economic sector—such as wholesale trade, food processing, and hospitality. A focused subset of 203 companies operating in food-related sectors (e.g., restaurants, cafés, baklava producers, grocery stores) was selected to analyze intersections between economic activity and cultural integration.

In line with the principles of analytical generalization (25), this subset was not statistically representative but theoretically significant. The empirical data were interpreted through the lens of cultural sociology, particularly drawing on Pierre Bourdieu's concept of embodied cultural capital and Homi Bhabha's theory of cultural hybridity. This interpretive framework enabled an understanding of how culinary practices function as sites of symbolic negotiation, integration, and social visibility.

Rather than claiming a full "mixed-methods" design, this research adopts a qualitative sociological interpretation of quantitative data, a methodologically valid practice especially when embedded within a robust theoretical framework (26). This approach permits in-depth cultural insight without the need for direct qualitative fieldwork.

The empirical case of Gaziantep thus illustrates broader regional dynamics concerning the role of refugee entrepreneurship in promoting cultural, economic, and social sustainability, while engaging conceptually with the United Nations Sustainable Development Goals (SDGs)—particularly SDG 8 (Decent Work), SDG 10 (Reduced Inequalities), SDG 11 (Sustainable Cities), and SDG 12 (Responsible Consumption and Production).

RESULT AND DISCUSSION

Since the onset of the Syrian civil war in 2011, Turkey has become a primary destination for displaced Syrians, with Gaziantep emerging as a key host city due to its geographical proximity and economic vitality. Over the years, Syrian refugees in Gaziantep have transitioned from humanitarian aid recipients to active economic participants. This study draws on firm-level data from the Gaziantep Chamber of Commerce

and Ministry of Trade to analyze the sectoral distribution and cultural impact of Syrian-owned businesses in the city. As of 2024, approximately 975 Syrian-owned firms operate in Gaziantep, the majority of which are concentrated in food-related industries such as wholesale trade, food manufacturing, and hospitality (Table 1).

Among these, 537 firms (55.1%) are engaged in wholesale food trade, underscoring the pivotal role of Syrian entrepreneurs in regional supply chains. Additionally, 84 firms operate in baklava, flour, and pastry production, while 74 run cafés, restaurants, and catering services, contributing to both the culinary economy and social fabric of Gaziantep. These businesses not only reinforce the city's position as a gastronomic capital but also facilitate cultural exchange through Levantine-Turkish culinary fusion. Syrian entrepreneurs have enriched the local foodscape by introducing new techniques and dishes such as *shawarma*, *muhammara*, and *Aleppo-style spices*, often adapted to local tastes to create hybrid food identities.

In this context, gastronomy functions as a driver of cultural and social sustainability, preserving heritage while enabling interaction across communities. As Carballo-Cruz and Saenz De Jubera (10) note, culinary exchange strengthens inclusivity and contributes to more resilient, multicultural societies. The case of Gaziantep illustrates this dynamic clearly: Syrian food businesses not only preserve and transmit cultural knowledge, but also generate employment, attract food tourism, and support innovation in food manufacturing (e.g., fusion baklava, dairy adaptations).

Importantly, the cultural transmission through food supports intergenerational continuity within refugee families while simultaneously introducing host communities to unfamiliar culinary traditions. As Hayes-Conroy and Hayes-Conroy (9) argue, food exchange is not just material but symbolic—conveying values, stories, and identities that foster empathy and solidarity. In Gaziantep, supermarkets and grocery stores (60 Syrian-owned firms) increasingly stock both Turkish and Syrian goods, contributing to shared everyday consumer experiences and mutual visibility.

Gaziantep's designation as a UNESCO Creative City of Gastronomy (14) further amplifies the relevance of Syrian culinary contributions. The arrival of Syrian food entrepreneurs has diversified the city's gastronomic identity, reinforcing its global culinary reputation and deepening cross-cultural interaction. Moreover, these businesses function as community hubs where locals and newcomers meet, share meals, and form social ties—contributing to social cohesion, tolerance, and mutual adaptation.

Table 1. Food firms established by Syrian refugees in Gaziantep

Profession Group (with NACE Codes)	Number of Companies
1. Agricultural Products - Grains - Pulses - Spices (NACE: 01.1, 01.2, 01.3, 46.3)	34
2. Flour Products - Baklava - Flour - Bulgur - Pulse Manufacturing (NACE: 10.1, 10.8, 46.3)	84
3. Pistachio and Nuts (NACE: 10.3, 46.3)	37
4. Sugary Products - Beverages - Chocolate - Dairy Products (NACE: 10.8, 10.5, 10.6, 46.3)	45
5. Food Wholesalers and All Kinds of Wholesale Trade (NACE: 46.1, 46.2, 46.3, 46.9)	537
6. Supermarkets - Grocery Stores (NACE: 47.1, 47.2)	60
7. Fresh - Dried Fruits and Vegetables Wholesale Trade (NACE: 46.3, 46.9)	67
8. Cafes - Restaurants - Catering Services (NACE: 56.1, 56.2, 56.3)	74
9. Live Animals - Animal Products and Feed Producers (NACE: 01.4, 01.5, 10.9)	37
Total	975

In conclusion, Syrian entrepreneurship in Gaziantep illustrates how gastronomy can serve as a powerful platform for both economic resilience and cultural sustainability. The integration of refugee food practices into local systems enriches not only the economy but also the social imagination of host communities. As Table 1 indicates, this sectoral distribution reflects a vibrant and growing field of economic participation rooted in culinary tradition and innovation. Moving forward, supportive policy frameworks that encourage collaboration between Syrian and Turkish entrepreneurs can further harness this potential, positioning gastronomy as a cornerstone of inclusive and sustainable development.

Connecting Cultural and Social Sustainability with Sustainable Development Goals

The integration of refugee gastronomy into local food cultures also has significant implications for sustainable development, particularly in the realms of economic growth, social inclusion, and environmental stewardship-three key pillars of the United Nations Sustainable Development Goals (SDGs).

Economic growth

Refugee-led food businesses contribute to local economies by creating jobs, generating income, and revitalizing neighborhoods. These businesses often introduce innovative food products and services that attract diverse customer bases, thereby stimulating local economic activity. Furthermore, by participating in local markets and food festivals, refugees enhance the vibrancy and diversity of the food industry, which can lead to broader economic benefits for the host community.

For example, over 5,000 Syrian-owned businesses are registered in Istanbul alone, making the city a leading hub for refugee entrepreneurship. While a precise sectoral breakdown is not publicly available, studies by UNDP (15) and IGAM (16) indicate that a significant portion of these enterprises operate in the food and hospitality sector, including restaurants, cafés, bakeries, and catering services.

In cities like Gaziantep, where approximately 23% of Syrian businesses in Turkey are located, establishments such as Aleppo Kitchen and Sultana Restaurant have become well-integrated into the local culinary landscape. These businesses not only provide employment to both Syrians and locals but also enrich the gastronomic diversity of the region. Moreover, many participate in local markets and food festivals, enhancing the vibrancy of the food sector and supporting inclusive economic growth.

According to this study and as demonstrated in Table 1, a significant number of Syrian-owned businesses in Gaziantep are active in three key sectors with high potential for cultural and economic integration:

Sweets and confectionery production (including baklava and traditional Middle Eastern desserts), restaurants, cafés, and catering services, food manufacturing and grocery retail.

These sectors (highlighted in red in Table 1) are closely tied to both local consumer culture and Gaziantep's gastronomic identity. In addition, other sectors identified in the research—such as wholesale food trade, dried fruits, spices, and agricultural products—primarily reflect Syrian merchants' participation in traditional commercial activities and demonstrate the transference of Syrian trade culture into Turkey's regional markets.

The economic empowerment of refugees through culinary entrepreneurship aligns directly with Sustainable Development Goal 8 (Decent Work and Economic Growth), as it promotes sustainable economic development and creates opportunities for dignified employment. These refugee-run food initiatives exemplify how grassroots entrepreneurship can play a vital role in building resilient and inclusive urban economies.

Social inclusion

The cultural exchange facilitated by refugee gastronomy directly supports SDG 10 (Reduced Inequalities) by promoting social inclusion and reducing inequalities within societies. When

refugees share their culinary traditions with local populations, they contribute to breaking down cultural barriers and fostering a sense of belonging.

In Turkey, where over 3.2 million Syrian refugees reside, gastronomy has emerged as a vital medium for intercultural dialogue and social cohesion. Refugee-operated food businesses—such as Syrian-owned dessert shops and cafés in Istanbul's "Little Damascus" (Aksaray)—serve not only as commercial venues but also as communal spaces for cultural interaction. These establishments are frequented by both local populations and other immigrant communities, enabling everyday encounters that challenge stereotypes and promote mutual understanding.

Community kitchens and culinary workshops further reinforce this process. Initiatives like Kırkayak Kültür's gastronomy programs (e.g., *Humus*) (17), in Gaziantep and SGDD-ASAM's cooking classes for refugees (18) and local women not only provide vocational training but also create spaces for storytelling, shared labor, and emotional connection. These programs often emphasize co-creation, such as in the case of the vegan restaurant Mutfakna (19), which symbolizes unity beyond ethnic and national boundaries.

Moreover, these food-centered interactions contribute to the development of informal social networks, through which refugees gain practical support—language practice, job opportunities, housing advice—that directly reduce barriers to full societal participation. In this way, culinary encounters are not merely symbolic but constitute tangible mechanisms for social integration, recognition, and empowerment.

According to the Gaziantep data presented in Table 1, the three culturally rich sectors mentioned earlier (restaurants, sweets production, and retail food services) are also key sites of cultural transmission and social cohesion. They facilitate daily face-to-face encounters between Turkish and Syrian populations and serve as intercultural bridges within the urban fabric. Meanwhile, the sectors with a more commercial orientation (e.g., wholesale trade of legumes, spices, dried fruits) represent an important continuation of Syrian commercial tradition, and illustrate how economic participation can coexist with deeper processes of cultural exchange.

By opening up cultural space in public life and enabling refugees to be seen as contributors rather than burdens, gastronomic engagement helps counteract marginalization and build more inclusive, equal societies. This grassroots cultural diplomacy complements institutional efforts and highlights the transformative potential of everyday practices in advancing the goals of equality and inclusion.

Environmental stewardship (SDG 12)

The culinary practices of many refugee communities often include sustainable food practices, such as the use of local and seasonal ingredients, traditional preservation methods, and waste minimization techniques. By introducing these practices to their host countries, refugees can contribute to more sustainable food systems, aligning with SDG 12 (Responsible Consumption and Production).

Additionally, the fusion of local and refugee culinary traditions can lead to the creation of new dishes that are both culturally significant and environmentally sustainable. These hybrid culinary forms represent a more thoughtful and resource-efficient approach to food production and consumption. In Gaziantep, sectors such as baklava and pastry production, nuts and dried fruits, and grocery trade (see Table 1) provide tangible examples of this integration. Many of these businesses operate on low-waste, seasonal, and handmade production models, reflecting culinary values grounded in both tradition and sustainability.

The integration of refugee gastronomy into local culinary landscapes thus serves as a powerful catalyst for cultural and social sustainability, which in turn supports the broader goals of sustainable development. By preserving cultural heritage, fostering social inclusion, and promoting economic and environmental sustainability, refugee culinary practices contribute to the creation of resilient, inclusive, and sustainable communities. These interactions

between refugee and local cuisines not only enrich the cultural and social fabric of host societies but also play a crucial role in building a sustainable future where diversity, solidarity, and ecological awareness are at the forefront of development.

Sustainable Cities and Communities (SDG 11)

The integration of refugee gastronomy into urban public life contributes directly to Sustainable Development Goal 11 (Sustainable Cities and Communities), which calls for inclusive, safe, resilient, and sustainable urban environments. Refugee-led food enterprises—such as Syrian-owned restaurants, cafés, bakeries, and community kitchens—play a transformative role in revitalizing urban spaces and enhancing social resilience at the neighborhood level.

In cities like Istanbul, the emergence of districts such as "Little Damascus" in Aksaray illustrates how refugee communities shape urban cultural geography through gastronomy. These spaces are not only centers of economic activity but also serve as cultural anchors where everyday encounters between locals and refugees foster mutual recognition and coexistence. Similarly, in Gaziantep, food establishments like Sultana, Aleppo Kitchen, and Mutfakna represent examples of how refugee food practices are embedded in the city's urban fabric, contributing to social interaction, spatial inclusion, and economic vitality.

Moreover, projects such as Kırkayak Kültür's refugee kitchens (17), Komşu Kafe Kolektifi (20), and SGDD-ASAM's (18) culinary workshops serve as hybrid urban commons, where food becomes a vehicle for shared identity, collective care, and urban participation. These initiatives illustrate how gastronomy fosters urban cohesion, turning food into a medium through which cultural sustainability and social justice intersect.

In light of the findings presented in Table 1, the clustering of Syrian-owned businesses in specific food-related sectors and districts reflects how migration-driven entrepreneurship can reshape the socio-spatial dynamics of Turkish cities. By contributing to urban vitality, cultural visibility, and inclusive economies, refugee gastronomy becomes a cornerstone of sustainable urban development, in line with the targets of SDG 11.

CONCLUSION

The integration of refugee gastronomy into local culinary landscapes is a complex, multidimensional process that plays a pivotal role in advancing cultural sustainability, social cohesion, and inclusive development. Through everyday culinary interactions—cooking, eating, and exchanging recipes—refugees and host communities co-create spaces of mutual recognition, shared identity, and evolving taste. These exchanges not only enrich the gastronomic diversity of host societies but also facilitate meaningful pathways for refugee participation in economic, social, and cultural life.

This study has demonstrated that refugee-led food practices are not merely cultural expressions but also powerful mechanisms for sustainable development and integration. Drawing on theoretical perspectives—such as Bourdieu's cultural capital, Bhabha's hybridity (2), and Appadurai's gastro-politics (3)—and supported by empirical data from Gaziantep, the research has shown how culinary entrepreneurship intersects with key Sustainable Development Goals, particularly SDG 8 (Decent Work and Economic Growth), SDG 10 (Reduced Inequalities), SDG 11 (Sustainable Cities and Communities), and SDG 12 (Responsible Consumption and Production).

In cities like Gaziantep, where refugee-owned food businesses have become integral to the urban landscape, gastronomy serves as both a cultural bridge and an economic engine. Initiatives that support refugee women's cooperatives—such as those facilitated by KEDV—and intercultural culinary projects provide powerful examples of how food can foster solidarity, visibility, and social resilience.

Looking ahead, the future of refugee gastronomy lies in its capacity to support economic empowerment, cultural preservation, and urban coexistence. By investing in sustainable food entrepreneurship, community-driven initiatives, and inclusive culinary spaces, refugees can

build dignified livelihoods while contributing to the cultural and economic vitality of their host societies (21).

To fully realize this potential, future integration policies must recognize food not only as a symbol of identity but also as a strategic tool for inclusion, economic development, and urban transformation. Local governments, civil society, and international actors should prioritize support mechanisms such as access to commercial kitchens, funding opportunities, business mentoring, and shared marketplaces.

Ultimately, every dish shared between communities tells a story—not just of displacement, but of creativity, endurance, and shared humanity. In embracing refugee gastronomy, we do not simply enrich our palates; we nourish the foundations of a more inclusive, resilient, and culturally vibrant society.

Conflict of Interest

No conflict of interest.

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Review Article / Derleme Makale

Geçmişten Günümüze Türk Tatlı Tarihi

History of Turkish Desserts from Past to Present

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Özet

Türklerin Orta Asya'dan Anadolu'ya kadar uzanan tarih serüveninde mutfak kültürleri birçok değişikliğe uğramıştır. Türklerin konar göçer yaşantıdan yerleşik hayata geçmesi, İslam'ın kabulü, ticari aktivite ve kültürel etkileşimleri sayesinde mutfak kültürleri çeşitlenmiştir. Bu çeşitlilik sürecinde tatlı kültürleri de önemli ölçüde gelişmiştir. Orta Asya Türklerinin, coğrafi ve kültürel koşullar sebebiyle tatlıları az veya hiç tüketmedikleri söylenebilir. Buna karşın zamanla gelişen imkanlar ve farklı coğrafi koşullar Türklerdeki tatlı tüketimini artırmış ve zamanla tatlı kültürlerinde ise çeşitliliğin zenginleşmesine yol açmıştır. Günümüzde ise tatlıların, Türk mutfağında çeşitliliğiyle vazgeçilmez bir yer edindiği söylenebilir. Türklerin geçmişte geleneksel olarak tükettikleri tatlıların bazıları günümüzde de popülerliğini korumaktadır. Buna rağmen bazı tatlıların unutulduğu veya geleneksel tariflerden farklı olarak üretildiği söylenebilir. Bu çalışmanın amacı; Türk Mutfak Kültürü ve Türklerin tatlı kültürleri hakkında literatüre katkı sağlamaktır. Çalışmada, literatürde bulunan benzer çalışmalardan farklı olarak Türk Mutfağından çok Türk Tatlı Kültürüne yer verilerek kapsamın daraltılması sağlanmıştır. Detaylı literatür taraması yapılarak Türklerin geçmişten günümüze kadar değişen tatlı kültürleri hakkında bilgi verilmiştir. Değişen tatlı kültürüyle unutulmaya yüz tutan bazı tatlıların tanıtılması veya geleneksellikten uzaklaşan tatlıların korunması hedeflenmektedir.

Abstract

The culinary cultures of Turks have undergone numerous changes throughout their historical journey from Central Asia to Anatolia. The transition of Turks from a nomadic lifestyle to a settled one, the acceptance of Islam, commercial activities, and cultural interactions have all contributed to the diversification of their culinary traditions. Within this process of diversification, the culture of sweets has also significantly developed. It can be said that the Turks of Central Asia consumed little to no sweets due to geographical and cultural conditions. However, over time, with improved opportunities and varying geographical conditions, the consumption of sweets among Turks increased, leading to greater diversity in their dessert culture. Today, it can be stated that sweets have become an indispensable part of Turkish cuisine due to their variety. Some of the sweets traditionally consumed by Turks in the past have retained their popularity today. Nevertheless, some desserts have been forgotten or are now produced differently from their traditional recipes. The aim of this study is to contribute to the literature on Turkish culinary culture and Turkish dessert traditions. Unlike similar studies in the literature, this research focuses more on Turkish dessert culture rather than the broader Turkish cuisine, thereby narrowing the scope. A detailed literature review has been conducted to provide information on the transformation of Turkish dessert culture from past to present. The study aims to introduce some nearly forgotten desserts and to preserve sweets that are drifting away from their traditional forms due to the evolving dessert culture.

Extended Summary

Throughout the history, Turks accommodated in different locations and ruled different countries. Thus, different geographical environments and cultural interactions with other countries affected the Turks' own culture over time [1]. While there are different opinions about the Turks' homeland, many researchers acknowledge the Middle Asia as Turks' homeland. Middle Asia's geography and Turks' nomad lifestyle are the fundamental for their cultural history [2]. Turks are mainly occupied with farming and trade of animal products [3]. Thus, their cuisine was based mainly with animal products. There are different opinions of Nomad Turks' dessert consumption. While some indicate that Nomadic Turks did not consume any dessert and thought desserts as disgraceful [4, 5], others indicate that they consumed products like desserts (aşpöri, kuyma, halwa) with sugar or honey [6–9]. Due to the sugar's rarity and expense, desserts with sugars were hard to find in any other countries too in this time [10]. Thus, honey, molasses, fruits etc. were common for dessert sweetening. There are not enough resources that supporting Nomadic Turks' dessert consumption, but dessert-like products are mentioned [6]. Due to their Tengri belief Turks believed that the smells of food calmed dead souls. It can be stated that Turks' traditional halwa for the dead based on that belief [11]. Additionally, it is stated that there was dough based, and meat-based dishes consumed with sugar [7, 8]. Yogurt with fruits, honey, and molasses; were consumed after or with dishes. These products can be an example to the desserts according to their high sugar content.

Seljuk period played an important role in the formation of the culinary culture of the Turks. During the Seljuk period, the Turks' adopted settled life, increased trade, spread of agriculture and increased cultural interaction, etc. have enabled the development of culinary culture [12, 13]. Unlike the Nomadic Turks, it is possible to obtain information about their culinary culture from various written resources. It can be said that sugar consumption was low during this period due to the difficulty of finding and its expense [13]. However, it is mentioned that there are many types of desserts flavored with honey, molasses, jam and fruits instead of sugar. In the Seljuks, various desserts were served at the end of banquets, and almond candies were handed out at weddings [14]. Many types of halva have emerged and are handed out to the public on various ceremonies and special occasions (veterans' halva, almond halvah, walnut halva, paper halva, etc.). Many types of halva were sold by people called "helva-ger" [6]. In the Seljuks, where health and food culture were together, it was thought that desserts or sherbets such as "gulbeseker" were good for diseases [15]. It is said that during this period, various pastry desserts (müşebbek, karamuş, senbuse), pelte, zerde and kadayıf were consumed with pleasure. Although there were people in the villages who did not consume sugar or even halva, processed types of sugar were sold in the cities (akide, teberzed, nebet, mahoş, etc.) [16].

Cuisine in the Ottoman Empire; developed due to reasons such as the good economy, different cultures that composed in the population, geographical conditions, and the interest of the nobles for eating. Especially palace cuisine developed due to the banquets, celebrations and to satisfy sultans [13]. The importance given to halva continued in the Ottoman Empire, and the kitchen section where desserts were prepared was called "Halvahane". In addition to desserts, sherbet, mesir pastes and medicine varieties are also prepared in this section [17]. Although the importance given to halva in the Ottoman Empire can be understood through the variety of halva, the failure to record the

recipes has prevented some halva from reaching the present day. Desserts during the Ottoman period can be divided into groups of halvas, milk desserts, pastry desserts and other desserts [18]. It can be said that almost all desserts containing flour/starch, honey/sugar and oil are considered halva [19]. Due to the importance of animal husbandry for Turks, the use of milk in desserts were common [20, 21]. Ottoman were consuming wide range of puddings (rice pudding, chicken pudding, muhallebi etc.) and some of the desserts are still popular among Turks. Doug-based desserts were abundant and diverse according to use of yeast, cooking method, shape, etc. [22]. It is mentioned that baklava and kadayıf type desserts are among the most loved dessert types by Turks [18]. There were other types of desserts and snacks such as pelte, zerde, aşure, sweet sausage etc. consumed in Ottoman. It can be said that with the Europeanization movement in the last periods of the Ottoman Empire, culinary cultures were influenced by French desserts and products from their cuisine [13].

Turkish Dessert culture during and after the Republic Period experienced a radical change due to technological developments [23]. Turkish cuisine, whose foundations were laid during the Seljuk and Ottoman Periods, has experienced great changes. Due to reasons such as the cheaper price of sugar and easy access to technological equipment and information, people have had the opportunity to try the types of desserts they were curious about [24]. Nowadays, it can be said that through social media, desserts from different cultures started to become more known and consumed than traditional Turkish desserts [25]. Although traditional baklava, milk desserts and halva are still consumed today; it can be said that some dessert varieties have begun to be forgotten over time. For such reasons, products have begun to be registered and protected by geographical indication and similar practices [12]. It can be said that after the Republic period, especially French pastry techniques and desserts began to become widespread among Turks [26]. When today's cafe and patisserie menus are examined; it is possible to see the cultural desserts of different countries (French, Italian, Japan, Korea etc.) [27]. The continuous development of gastronomy and various trends also increases the competition between chefs. For this reason, it can be said that traditional products have been developed, and new desserts have been created [28]. Consequently, it can be said that Turkish dessert culture is rapidly expanding and diversifying due to recent developments.

GİRİŞ

Farklı ülke ve kültürlerin sahip olduğu gastronomik değerler, coğrafi şartlara bağlı olarak oluşmakta, gelişmekte ve değişmektedir [29]. Geniş bir coğrafyaya yayılan Türklerin, diğer ülke ve kültürlerle etkileşimi, kendi kültürlerini çeşitlendirmiştir [1]. Türklerin Orta Asya'dan başlayan tarihi, konar göçer yaşam stilleri sebebiyle yazılı kaynaklara erişimi zorlaştırmıştır. Bu sebeple Türklerin eski dönem kültürel miras öğelerine; "şifahi gelenek" olarak adlandırılan sözlü kaynaklar ve bazı yazıtlar sayesinde ulaşılmıştır [2]. Türklerin tarih boyunca büyük bir coğrafyaya yayılması kökenlerinin kesin olarak belirtilmesini güçleştirmektedir. Buna karşın Türklerin anavatanı birçok kaynakta Orta Asya olarak gösterilmektedir [30]. Türkler, Orta Asya'da yaşadıkları dönem boyunca bozkırda hayvancılıkla uğraşmışlardır. Bu sebeple hayvansal gıdaların, diyetlerinde temel besin kaynağı olarak kullanıldığı düşünülmektedir [3]. Türklerin konar-göçer dönemdeki yaşantıları sebebiyle yemek kültürleri hakkında kesin bilgilere ulaşılamamaktadır. Ek olarak gıda ürünlerinin kısıtlı ve kültürel etkileşimin diğer dönemlere oranla az olması sebebiyle yemek çeşitliliğinin fazla olmadığı söylenebilir [31]. Selçuklu Dönemi'nde ise yerleşik hayata geçilmesi, diğer kültürler ile olan etkileşim vb. gibi birçok etmen; Türklerin mutfak kültürünü geliştirmiştir [32]. Bu dönemlerde gezginler tarafından hazırlanan yazılı kaynaklar dönemin yemek kültürü hakkında bilgi edinilmesini sağlamıştır [33]. Selçuklu Dönemi'nden sonra Osmanlı'nın farklı kıtalara yayılmış olması, ekonominin iyi olması, kültürel etkileşim ve halkın yiyecek-içecek kültürüne olan ilgisi gibi birçok sebep bu dönemdeki mutfak kültürünü büyük ölçüde geliştirmiştir [10]. Osmanlı'nın son dönemleri göz önüne alındığında Avrupalılaşmanın da etkisiyle mutfak kültürünün de geleneksel gıdalardan uzaklaştığı bir dönem olduğu söylenebilir [13]. Cumhuriyet Dönemi sonrasında ise gelişen teknoloji, ulaşım, çok kültürlü yapı vb. gibi etmenlerin Türklerin yiyecek-içecek alışkanlıklarını ve yemek kültürlerini değiştirdiği söylenebilir [34]. Günümüzde dünya genelinde çeşitli gastronomik trendlerin oluşması, yeni ürün geliştirme teknikleri ve şefler arasındaki rekabet; yiyecek-içecek sektörüne çeşitlilik kat-

maktadır [28]. 19. Yüzyıla kadar ülkelerin politik, ekonomik, ticaret vb. nedenler dolayısıyla şehir ve kırsal alanlardaki mutfak kültürleri arasında büyük farklılık bulunduğu söylenebilir. Günümüzde ise teknolojinin gelişmesi ve kolay erişilebilirlik sebepleriyle kırsal kesimlerde de mutfak kültürünün çeşitlendiği söylenebilir. Günümüz Türk Mutfak Kültürü incelendiğinde, butik işletmeler, fine-dining restoranlar, geleneksel lokantalar, meyhaneler, tematik kafeler gibi birçok farklı yiyecek-içecek işletmesi göze çarpmaktadır [35, 36]. Bu işletmelerin özgün tariflerinin zamanla Türklerin kültürel öğeleri arasına girebileceği söylenebilir. Bu çalışmada; Türk tatlı kültürünün Orta Asya Dönemi'nden günümüze kadar geçirmiş olduğu süreç ve değişimin tanıtılması amaçlanmıştır. Literatürde Türk mutfak kültürü kurulan devlet dönemlerine göre ayrılmasına karşın, Türk tatlı kültürüyle ilgili yeterli kaynak bulunmadığı söylenebilir. Bu doğrultuda çalışmanın Türk tatlı kültürü hakkında literatüre katkı sağlaması amaçlanmaktadır.

METODOLOJİ

Çalışma hedeflerine ulaşılması için nitel araştırma yöntemleri kullanılmış olup, konu ile ilgili literatür derinlemesine incelenmiştir. Türklerin ilk yurdu olarak varsayılan Orta Asya Dönemi'nden başlayarak; Selçuklu Dönemi, Osmanlı Dönemi ve Cumhuriyet Dönemi Türk mutfak kültürü incelenerek, zaman içerisinde Türklerin tatlı kültüründeki gelişimi değerlendirilmiştir. Literatür taraması sonucunda elde edilen veriler karşılaştırılarak içerik analizi yöntemiyle yorumlanmıştır. Özellikle Orta Asya ve Selçuklu Dönemi'ndeki tatlı kültürü hakkında yazılı kaynakların kısıtlı olması nedeniyle; dönemin meslekleri, mutfak araç gereçleri, yüksek şeker oranına sahip gıdaların kullanımı gibi unsurlardan yola çıkarak, zaman içinde tatlıların gelişimi hakkında çıkarımlarda bulunulmuştur. Bu bağlamda; çalışmanın literatür taraması desenine sahip betimleyici nitel çalışma olduğu söylenebilir.

BULGULAR

Orta Asya Türkleri ve Tatlı

Hun Devleti ile ilgili araştırma ve bulgular Orta Asya Türk mutfağı adına elde edilen ilk bilgiler olarak sayılabilmektedir. Hunların diğer Türkler gibi hayvansal gıda ürünleri (süt, koyun, yoğurt, kımız at eti vb.) kullandıkları bunun yanında arpa, pirinç ve darı da tükettikleri bilinmektedir [13]. Bu dönemde tarımla da uğraşan Türkler, yetiştiremedikleri gıda ürünleri için hayvanlardan elde ettikleri keçe, yün, yün örtü gibi ürünlerin ticaretini yapmışlardır [3]. Bazı kaynaklarda Orta Asya Türklerinin tatlı hazırlamadığı, tüketmediği ya da tatlı tüketimini ayıp olarak nitelendirdiği belirtilmektedir [4, 5]. Buna karşın, bazı kaynaklar Türklerin tatlı tükettiğini; pekmez ve bal gibi ürünlerle de tatlı ihtiyaçlarını giderdiklerini belirtmektedir [6]. Dolayısıyla bahsedilen tatlıların içeriklerinde bulunan bazı ürünler nedeniyle hoş karşılanmamış olabileceği düşünülebilir.

Günümüzde hala önemli yere sahip olan hamur işi ürünlerinin, temel olarak Orta Asya'daki göçebe Türklerden kaynaklandığı söylenebilir [7]. Bu dönemde "aşpöri" adı verilen külde pişen çörek ve yağlı bir ekmek çeşidi olan "kuyma" üzerlerine şeker serpilerek tüketilmiştir. Buna ek olarak, tiftiklemiş et, yağ, un ve şekerden oluşan, "kara etmek" adlı başka bir tatlı yemeğin de yapıldığı belirtilmektedir [8]. Türkler, Tengri inanışları dolayısıyla yemek pişirilirken çıkan bazı kokuların ölenlerin ruhlarına huzur sağladığını düşünmüşlerdir [11]. Bu sebeple arpa buğday ve mısır unu gibi tahıl bazlı ürünlerin yağla kavrularak koku çıkartma işleminin uygulandığı bilinmektedir. Bu işlem sonrasında; şeker, pekmez/bal ile lezzetlendirilerek günümüz helvalarına benzer ürünlerin tüketildiği belirtilmektedir [9]. Kavut olarak da adlandırılan bu ürünün; ölüm sonrasında hazırlanması, sunulması ve mezarlıklarda dağıtılması günümüzdeki helva ikramının başlangıcı olarak düşünülebilmektedir [38,39].

Türklerin bu dönemde göçebe yaşamları dolayısıyla et, yoğurt, meyve ve sebze ürünlerini kurutup sakladıkları bilinmektedir [39]. Meyve ve sebzelerin kurutulması sonucunda, su kaybı nedeniyle şeker oranlarının da arttığı belirtilmektedir [40]. Bu sebeple, Türklerin tatlı ihtiyaçlarını çoğunlukla kuru meyve ve sebzelerle karşılamış olabilecekleri de düşünülebilmektedir. Ek olarak; bu dönemde şekerin kolay ulaşılabilir olması [18], bazı Türklerin tatlıları hoş karşılamaması [41] gibi etmenler, Türk tatlı çeşitliliğinin

az olduğunu göstermektedir. Fakat, dönemin mutfak ve tatlı kültürüne ait kaynaklarının kısıtlı olduğu göz önünde bulundurulmalıdır [31, 33]. Göçebe dönemde tüketilen kurutulmuş meyve [32], boza [42], bal, pekmez ve meyve katılmış yoğurt gibi ürünlerin, sonraki dönemlerde ziyafet sonlarında tatlı yerine verildiği belirtilmektedir [9].

Selçuklu Dönemi Tatlı Kültürü

Selçuklu Devleti; İran, Orta Asya, Bizans ve Arap kültürleriyle etkileşime girmiş, Türk Mutfak Kültürünün yapısının oluşmasında ve gelişmesinde önemli rol oynamıştır [13]. Bu dönemde hayvancılık önemli geçim kaynakları arasında yer almaya devam etmiştir. Devletin yerleşik hayatı benimseme ile tarım yaygınlaşmış, yetiştirilemeyen ürünler ise ticaret yoluyla ithal edilmiştir [12]. Bunun sonucunda tahıllar, baklagiller, sebzeler, meyveler, baharatlar ve hayvansal gıda çeşitliliklerinde artış gerçekleşmiştir [43]. Mevlânâ'nın kaynaklarından yola çıkarak hazırlanan mesnevi mutfağı, İbn Batuta ve İbn Bîbî gibi gezginlerin hazırlamış olduğu seyahatnameler, Divânü Lûgati't-Türk, Dede Korkut Hikâyeleri ve vakıf belgeleri dönemin mutfağı hakkında bilgiler vermektedir [31, 32, 41, 44]. Sofra adabı olarak ortaya konulan sini üzerinden çatal, bıçak ve kaşık kullanılarak yemek yenildiği ve misafirperverliğe son derece önem verdikleri bilinmektedir [43].

Göçebe dönemde Türk tatlılarının az tüketimi [4] ve tatlılara karşı olan olumsuz tutum, Türklerin Araplar ile olan etkileşimleri sonucu değişmiş ve tatlı tüketimlerinde artışa neden olmuştur [41]. Tatlılar çoğunlukla bal, pekmez (dut, üzüm, nar) ve şeker kullanılarak hazırlanmıştır. Tatlıların özellikle şehirlerde tüketildiğine, bazı köylülerin tatlı veya helva dahi tatmadığına Mevlâna kaynaklarından ulaşılabilmektedir [13]. Bu sebeple tatlıların daha çok ticaret yapılan şehirlerde yaygınlaşmaya başladığı fakat köylerde hala tüketiminin gelişmediği sonucuna varılabilir.

Selçuklularda tatlı ve şerbetlerin şekerle lezzetlendirilerek tüketildiğinden bahsedilmektedir. Şekerin pahalı ve zor bulunan bir ürün olması sebebiyle sık sık pekmez, bal ve reçel kullanıldığı belirtilmektedir. Buna rağmen bazı kaynaklarda halkın bal ile lezzetlendirilen tatlıları daha çok beğendiği geçmektedir [14]. Selçuklularda, tatlılara ek olarak çeşitli şekerlemeler de kültürel ürünler arasında yer almaya başlamıştır. Maddi duruma bağlı olarak düğünlerde takı ve altının yanında badem şekerinin de saçıldığı ve davetliler tarafından toplandığı bilinmektedir [45]. Kannâd olarak adlandırılan dönemin şekercileri, Mısır'dan alınan şeker kamışlarını işleyerek çeşitli şeker türleri üretmişlerdir [43]. Selçuklularda attâr (aktar) olarak adlandırılan baharatçılarda, iğne-iplik satan dükkanlarda işlenmiş şekerlerin satıldığı bilinmektedir [16]. Kelle şekeri, akide şekeri, teberzed şekeri, mahoş nebet şekeri ve badem şekeri kayıtlarda geçen işlenmiş şeker türlerinden bazılarıdır [16, 46]. İşlenmiş ve tüketime hazır olarak getirilen şekerler; şeker hanları/çarşıları ve şeker-furuş denilen yerlerde satılmıştır [16, 47].

Selçuklular günümüzde olduğu gibi çeşitli helvaları özel günlerde hazırlamış ve ikram etmiştir [13]. Bu dönemde helva, çeşitlilik olarak artış göstermiş ve kültürel bir boyut kazanarak en çok tüketilen tatlı olarak bahsedilmiştir [6]. Selçuklu Döneminde helvalar irmik, un, nişasta ve çeşitli yemişlerin kullanılmasıyla halk tarafından hazırlanmıştır [46]. Ek olarak, helva-ger olarak adlandırılan helva satıcıları tarafından satılmıştır [16]. Helva çeşidi olan pişmaniyenin bu dönemde atıştırmalık olarak İran'dan "küllük helvası" olarak geçtiği düşünülmektedir [13]. Gaziler, keten, badem, ceviz, kâğıt, irmik, nişasta ve susam helvaları; Selçuklularda tüketildiği düşünülen helva çeşitlerinden bazılarıdır [48].

Gülbeşeker, halk tarafından sevilen diğer bir tatlı olarak öne çıkmakta olup, bal/şeker ve limon ile kokulu gül yapraklarının ezilmesi sonucunda hazırlanmaktaydı [15]. Hastalara kanlarının artması ve şifa olması amacıyla halk tarafından sıklıkla gülbeşekerden yapılan tatlı, şerbet veya şeker verildiği belirtilmektedir [49]. Mevlâna kaynaklarında geçen gülbeşeker, farklı benzetme ve abartılarla göze çarpmaktadır [43]. Arap mutfağına özgü bir tatlı olan kadayıf, bu dönemde de hazırlanan gıdalar arasında bahsedilmektedir [50]. Türk mutfağı ile gelişen ve farklı çeşitleri olan kadayıfın Selçuklarda yassı kadayıf olarak servis edildiği düşünülmektedir [13]. Kadayıfın

aşhanelerde ve sultanlara sunulan yemek listelerinde yer aldığı ve tüketildiği bilinmektedir [51].

Günümüzde pelte olarak bilinen tatlının ise İran kökenli olup, Selçuklularda bal ve yağ kullanılarak hazırlandığı, safran, gülsuyu veya bademle lezzetlendirildiği bilinmektedir [13, 50]. Pâluze, fâlûzec ya da pâlûda olarak da adlandırılan bu tatlı çeşidi, Osmanlı Döneminde çeşitlenmiş ve farklı ürünler kullanılarak hazırlanmıştır [18].

Kaynaklarda geçen diğer tatlılar ise; börek benzeri senbûse, pirinç, safran, şeker/bal veya gülsuyu ile hazırlanan zerde, yağda kızartılarak hazırlanan hamur işi tatlı müşebbek ve karamuş olarak göze çarpmaktadır [13]. Ek olarak halk tarafından farklı meyvelerden reçel ve pekmezlerin yapıldığı, ziyafetlerde ise yemek sonunda bal ve kaymağın servis edildiği bilinmektedir [52]. Yemeklerini kuşluk ve akşam olarak iki öğün tüketen Selçuklular [53], şeker oranları yüksek çeşitli meyveleri ise ara öğün olarak tüketmişlerdir [4, 13, 16, 52]. Taze olarak tüketilen bu meyveler, göçebe dönemde olduğu gibi kurutularak saklanmış ve tüketilmiştir [39]. Tatlı ve ekşi olarak iki çeşidi olan "Bekni" (boza), bu dönemde de sevilerek tüketilmiştir [54].

Osmanlı Dönemi ve Tatlı

Osmanlı'da; çok kültürlü yapı, farklı iklim ve bitki örtülerine sahip topraklar, ticaret yolları, zengin kesimin yemeğe olan merakı gibi birçok farklı sebep mutfak kültürünün gelişiminde önemli rol oynamıştır [10]. 1299 yılından 1923 yılına kadar olan süreci kapsayan Osmanlı Mutfak Kültürü, devletin siyasi ve ekonomik süreçlerine göre farklılık göstermiştir [55]. Beş yüz yıldan uzun süren bu tarihi süreçteki mutfak kültürünü; Erken Osmanlı Dönemi, Yükselme Dönemi ve Dağılma Dönemi olarak üçe ayırmak mümkündür [13].

Dönemin mutfak kültürü birçok kaynak tarafından "Osmanlı Saray Mutfağı" ve "Halk Mutfağı" olmak üzere ikiye ayrılmıştır [56, 57]. Saray mutfağı; devletin ileri gelenleri, saray yetkilileri, padişah ve ailesinin tüketmiş olduğu yemekler olarak tanımlanabilir [10]. Anadolu'da tüketilen yemekler ise halk mutfağı olarak tanımlanmaktadır. Buna karşın, devlet çalışanlarının Anadolu'daki görevleri sırasında saray mutfağını çeşitli yollardan halka tanıttığı düşünülmektedir [13]. Osmanlı saraylarında Matbah-ı Âmire olarak adlandırılan kompleksin, tüm saray yemekleri ve çeşitli etkinliklerden sorumlu olduğu bilinmektedir. Kompleks, kiler, mutfak ve fırınları içeren büyük bir yapıdan oluşmaktaydı [17]. Şölen ve ziyafetlerde sunulan yemek çeşitliliğinin (deniz mahsulleri, et yemekleri, şerbetler, pilavlar, çorbalar, tatlılar vb.), özel günler ve misafirperverliğe verilen önemi gösterdiği düşünülmekteydi [46]. Osmanlı'nın vermiş olduğu bu ziyafetler sonucunda yabancıların Türk yemeklerine ilgilerinin arttığı ve aşçılarını eğitmek için Osmanlı'ya gönderdikleri belirtilmektedir [22, 58]. Buna karşın, Osmanlı'nın son dönemlerinde verilen ziyafet menülerinde Türk yemekleri yerine Avrupa mutfağına özgü yemeklerin servis edildiği söylenebilir [13].

Helvahane ve Helva

Osmanlı Devletindeki Matbah-ı Âmire Emâneti'nin kesin kuruluş tarihinin bilinmediği, fakat Fatih zamanında Topkapı Sarayı'nın inşası sonrası görevlendirme ile yapıldığı tahmin edilmektedir [17]. Padişahların dönemleri boyunca farklılaşan ve genişleyen Matbah-ı Âmire; Has Mutfak, Divan Mutfağı, Ağalar Mutfağı, Helvahane, Kiler, Fırınlar, Kalayhane, Şemafer Kârhanesi gibi bölümlerden oluşmaktadır [59]. Helvahâne, 16.yüzyılda Matbahı Amire'ye bağlı olarak saraydaki tatlı-ekşi yiyecek ve içeceklerin imalatı için kurulmuştur [17]. Özellikle tatlı ve şerbetlerin üretimi ve depolanmasından sorumlu olunması sebebiyle, şerbethane olarak da adlandırıldığı söylenmektedir [60]. Helvahâne'de üretilen reçel çeşitliliği sebebiyle, ayrı bir bölüm olarak reçelhâne bulunduğu belirtilmektedir [17, 61]. Helva, reçel, şerbet, şurup, macun ve boza gibi birçok yiyecek ve içecek ürünlerinin yanında, helvahânelerde ilaç [62], sabun, esans ve kimyevî bileşimlerin de imalatı yapılmıştır [17].

Arapça "hulv" kelimesinden gelen helva, kelime olarak tatlı anlamına gelmekte olup, Türklerde önemli bir yer edinmiştir [19]. Osmanlı döneminde Arapçanın da etkisi ile un/nişasta, bal/şeker ve yağ kullanılan tüm tatlıların "helva" olarak nitelendirildiği belirtilmektedir [5]. Türkler, geçmişten beri un (gaziler helvası), nişasta, irmik, bal, keten helvaları gibi çeşitli helvalar

tüketmişlerdir. Ek olarak, yapım aşamalarının günümüze aktarılamadığı, fakat saray mutfağında hazırlanan birçok helva çeşidinin olduğu söylenmektedir [18]. Anadolu'da helva sohbetleri gerçekleştirilerek, türkü ve oyunlar eşliğinde çeşitli helvaların hazırlanması; helvanın kültürel bir öneme sahip olduğunu göstermektedir [63].

Sütlü Tatlılar

Sütlü tatlılar; ana malzemesinde süt bulunan, çeşitli şekerlerle tatlandırılan, nişasta ve un gibi ürünlerle kıvam verilen; doku, aroma ve içerik yönünden zenginleştirilebilen hafif tatlılar olarak tanımlanmaktadır [64, 65]. Bazı kaynaklarda göçebe dönemde tatlı tüketilmediği belirtilmiş olmasına karşın, sütle pişirilerek bal/pekmez ile lezzetlendirilen yemekler hakkında bilgiler bulunmaktadır [20, 21]. 15.yüzyıl Osmanlıca tıp kitapları ve Kaygusuz Abdal şiirlerinde "sütlü aş" ya da "sütlü pirinç" olarak adlandırılan sütlaç benzeri tatlılar, bu kategoride sınıflandırılabilmektedir [18, 66]. Sütlaca benzer bir tatlı olan "uwa" geçmişte Divan-ü Lügati't Türk'te geçmektedir [44]. Geçmişte farklı türleri bulanan ve günümüzde hala tüketilen sütlacın Osmanlı'da İtalyanlar tarafından da beğenildiği belirtilmektedir [18]. Sütlü tatlılar, günümüzde ve Osmanlı zamanında muhallebi olarak da adlandırılmakta olup, farklı türleri saray mutfağında ve ziyafetlerde sıklıkla tüketilmiştir [67]. Et, pirinç, şeker/bal ile hazırlanan muhallebinin, etsiz olarak pudra şekeri ve tarçın eklenerek çeşitli türleriyle (tavuklu, tavuksuz, ballı, güllü vb.) tüketildiği bilinmektedir [18, 68].

Hamur İşi Tatlılar

Hamur işleri, Türk mutfağında geçmişten beri yemek ve tatlılarda önemli bir yer tutmaktadır [22]. Osmanlı zamanında tatlıların Helvahânede yapılmasına karşın, hamur işi tatlıların farklı bölümlerde yapıldığı düşünülmektedir [17]. Bu dönemdeki hamur işi tatlılar; içeriği, mayalı olup olmaması, yumurta kullanılması, pişirme şekilleri vb. gibi birçok farklı unsura göre sınıflandırılabilmektedir [69]. Baklava, Türklerin severek ve en çok tükettiği hamur işi tatlılarından biri olarak göze çarpmaktadır [70]. Osmanlı'da özellikle Ramazan ayları ve bayram günlerinde hazırlanmış olup, saray ve halk arasında farklı kutlama ve etkinliklerde de hazırlanmıştır [71]. Saray yetkilileri ve padişaha sunulmak üzere baklavaların çeşitlendirildiği (kavunlu, peynirli, börülceli) ve geliştirildiği söylenebilir [18].

Kadayıf Osmanlı döneminde tüketilen hamur işi tatlılardan biri olarak göze çarpmaktadır [13]. Arapça "kadife", Osmanlıcada "kata'if" olarak geçen yassı kadayıf ve "kinafa" kelimesinden gelen tel kadayıfın bu dönemde yaygın olarak kullanıldığı belirtilmektedir [18, 72]. Bu iki kadayıf türünün tarif ve ayrımına Şirvanî'nin eserinde de değinilmiştir [68]. Baklava ile benzer olarak kadayıfın birçok tatlıyı kapsadığı söylenebilir [18]. Melceü't-Tabbâhin adlı kitabın altıncı bölümü olan hamur işi tatlılarda; kadife, ekmek kadayıfı, saray tel kadayıfı, fodula, yufkalı kadayıf, yağsız kadayıf gibi çeşitlerine rastlamak mümkündür [73]. Lokma benzeri kızartıldıktan sonra şerbetlenen hamurlar, tulumba, güllaç, şeker börek, halkaçini, kurabiye gibi hamur işi tatlıları da saray mutfağında geçmektedir [13].

Diğer Tatlılar

Osmanlı'da hazırlanan sütlü tatlılar, helvalar ve hamur işi tatlılar dışındaki tüm tatlılar bu kategori altında sıralanabilir. Selçuklu dönemi de dahil olmak üzere reçellerin önemi ve çeşitliliği Osmanlı'da artış göstermiş, tatlı olarak yemek sonrasında ikram edilmiştir [13]. Bu dönemde hazırlanan reçeller sadece meyvelerle sınırlı kalmamış olup; çiçek, bitki, yemiş, baharat gibi farklı ürünlerin de kullanımıyla reçeller hazırlanarak tatlıları lezzetlendirmek için de kullanılmıştır [18]. Çeşitli baharat, bitki, sebze ve meyveler kullanılarak hazırlanan, bal/şeker ile tatlandırılan macunlar da tatlı olarak tüketilmiştir [18, 74]. Dönemin tıp kitapları, macunun hastaları tedavi için kullanıldığını belirtmiş olup, çeşitli yapım aşamalarını içermektedir [75].

Sütlü tatlılardan farklı olarak; ana malzemesi çeşitli sıvı, nişasta ve bal/şeker olan pelte tatlısının Osmanlı'da sevilerek tüketildiği belirtilmektedir [18]. Birçok kaynakta "palude" ya da "paluze" olarak geçen tatlının üzüm suyu, badem, bal ve nişasta kullanılarak hazırlandığı, gül suyu ile servis edildiği aktarılmaktadır [76, 77]. Günümüzde bu tatlının bazı çeşitlerinin hala tüketildiği söylenebilmektedir [78]. Kıvam olarak pelte

ve sütlü tatlılara benzetilen zerde ve aşure de Osmanlı'da yaygın olarak tüketilmiştir [18]. Zerde, uzun bir geçmişe sahip olmakla birlikte Osmanlı döneminde düğün, sünnet ve bayram gibi kutlamalarda dağıtılmıştır [79]. Aşure tatlısı ise pek çok dini olaylara atfedilmiş ve zamanla Türklerde de yaygınlaşmıştır [80]. İslam geleneği olarak bilinmesine karşın tarihinin daha eskiye dayandığı söylenebilir. Aşure özellikle buğdayın kutsallık ve bereketi simgelemesiyle Anadolu'da çeşitli şekillerde tüketilmiştir [81]. Farklı kültürel etkinlik ve yeni yıl törenleri vb. gibi birçok özel günlerde hazırlanan aşure, günümüzde hala dini ve geleneksel sebeplerle üretilmektedir [82]. Osmanlı'da atıştırmalık/tatlı olarak ipe dizili ve dışı üzüm suyundan hazırlanan pelte kaplı kuruyemişler tüketilmiştir [83]. Günümüzde hala tüketilen ve farklı adlarla da anılan tatlı sucuk veya köfter, Osmanlı zamanında da birçok seyyar satıcı tarafından satılmıştır [18].

Cumhuriyet Dönemi ve Tatlı

Osmanlı Dönemi sonlarında başlayan Avrupalılaşma akımı, mutfak kültüründe de önemli ölçüde gerçekleşmiştir. Ziyafet, kutlama ve birçok etkinlikte dünya mutfaklarına özgü yemeklerin sunulduğu davet menülerinden anlaşılabilmektedir [13]. Bu sebeple, resmi kurum ve saraylarda çalışan aşçıların yemek tarifleri çeşitlilik göstermiştir. Ek olarak 19.yüzyıl ve sonrasında Amerika'dan gelen ürünlerin yetiştirilmesi veya kullanımının yaygınlaşması Türk mutfağını da etkilemiştir [23]. Cumhuriyet sonrası gelişen hızlı teknoloji ve küreselleşme, bilgi paylaşımını kolaylaştırmış, bu sayede Türk Mutfak Kültürü de çeşitlilik kazanmıştır [36]. Günümüz mutfak kültürü incelendiğinde, farklı ülkelere ait yemek kültürlerinden izler görmek mümkündür [34]. Tanzimat Fermanı ve Batılılaşma süreci sonrasında Fransız tatlı kültüründen etkilenen Türkler, pasta, çeşitli kremalar, kakao ve çikolata gibi çeşitli tatlı ve ürünleri kullanmaya başlamıştır [53].

Cumhuriyet Dönemi sonrasında yazılan yemek kitapları incelendiğinde, Fransız tatlı ve tariflerinin yer aldığı gözlenmektedir. Özellikle İstanbul'da hızlı üne kavuşmuş olan bu tatlılar (kekler, profiterol, milföy, krep, pastacı kreması, supangle vb.) günümüzde hala tüketilmektedir [26]. Gastronomi alanındaki trendler ve sosyal medya aracılığıyla tatlı kültürünün gelişmeye devam ettiği söylenebilmektedir [28]. Özellikle insanların yemek yeme alışkanlığının farklı tecrübe edinme isteğine yöneldiği, bu nedenle günümüz şeflerinin farklı tatlar ve reçeteler elde etme arayışına girdiği savunulabilir [84]. Ters bir görüş olarak ise gelenekselliğin savunulduğu ve geleneksel tariflerin unutulmaması gerektiğini savunan şefler de bulunmaktadır. Bu gibi sebepler doğrultusunda; günümüzde çeşitli restoran/kafe temaları olan yiyecek içecek işletmelerinin sayısı artmaktadır [85].

Geçmiş dönemden farklı olarak yalnızca İstanbul'da değil, Türkiye genelinde birçok pastane, fırın ve tatlı işletmeleri aktif olarak çalışmaktadır [24, 86]. Osmanlı Döneminde seyyar olarak satılan tatlılar, günümüzde çoğunlukla pastane ve fırınlarda satılmaktadır. Buna karşın; butik pastane, tematik kafe gibi birçok işletmede ise farklı ülke mutfaklarına özgü tatlıların sunulduğu gözlenmektedir [25]. Günümüzde yaygın olarak sütlü tatlılar, künefe, waffle, tiramisu, dondurma, turta, kek ve pasta gibi tatlıların sevilerek tüketildiği belirtilmektedir [87]. Daha önce bahsedilen etmenler sebebiyle (gastronominin gelişmesi, küresellik, kolay bilgi alışverişi vb.), popüler hale gelen tatlıların Türk mutfak kültüründe yer edindiği kesin olarak belirtilememektedir. Buna karşın coğrafi işaret tescili gibi uygulamalar, yeni ürünlerin Türk mutfak kültürüne kazandırılmasında önemli bir rol oynamaktadır. Ek olarak yiyecek-içecek işletmelerinde şefler tarafından oluşturulan ürünlerin zamanla kültürel değere sahip olabileceği de düşünülebilir.

SONUÇ

Türklerin tarih boyunca birçok farklı bölgede yaşadığı ve devlet kurduğu bilinmektedir. Türklerin bu farklı coğrafyalardaki ürünleri kullanarak hazırladıkları yiyecek ve içecekler yemek kültürlerinin temelini oluşturmuştur. Farklı kültürlerle etkileşimin artması, ticaret, tarım ve farklı coğrafyalardaki ürünler ise Türk mutfak kültürünün gelişmesini ve çeşitlenmesini sağlamıştır. Özellikle Osmanlı Dönemi'nde, Türklerin farklı kıtalara yayılması ve devlet görevlilerinin yabancılardan oluşması Türk mutfak kültürünü geliştirmiştir. Türklerin konar-göçer

yaşamlarında tatlı tüketimi yok denecek kadar az olmasına karşın; yerleşik hayata geçilmesi ve ticaret ile bal/pekmez gibi ürünlerin elde edilmesi, günümüze kadar ulaşan geleneksel tatlıların temellerini atmıştır. Selçuklu ve Osmanlı döneminde ise meyve, reçel, bal, pekmez ve şeker kullanılarak hazırlanan birçok tatlı çeşidi ortaya çıkmıştır. Osmanlı'nın son dönemlerinde ise Avrupa'da yaygın olarak kullanılan tatlılar saraylarda ve ziyafetlerde servis edilmiştir. Cumhuriyet Dönemi'nde ise teknolojinin gelişmesi ile farklı kültürlerin tatlıları evlerde ya da yiyecek-içecek işletmelerinde hazırlanmaya başlanmıştır. Günümüzde supangle ve pudingten, ekler ve doughnuta kadar birçok farklı tatlının, kafelerde, pastanelerde ve evlerde hazırlandığını söylemek mümkündür. Buna karşın geleneksel tatlılardan olan baklava, sütlü tatlılar, hamur işi tatlılar gibi birçok tatlı da hala tüketilmektedir. Fakat gülbeşeker, samsa, patlıcan tatlısı, sigara tatlısı gibi kayıtları bulunan Türk tatlıların günümüzde tüketilmediği bilinmektedir. Ek olarak tavuk göğsü ve kazandibi gibi tatlıların geleneksel olarak tavuk, pirinç unu ve süt kullanılarak hazırlanmasına karşın; günümüzde tavuksuz ve nişasta kullanılarak hazırlanması da yaygındır. Bu gibi tariflerin zamanla farklılaşması, geleneksel ürünlerin unutulmasına zemin hazırlayabilmektedir. Bu sebeple coğrafi işaret gibi ürün tescili uygulamalarıyla geleneksel lezzetlerin dünya genelinde tanıtılması sağlanabilir. Gelişen gastronomi sektöründe, şeflerin geleneksel tarifleri yeni teknik ve malzemelerle geliştirerek, kültürel mutfak öğelerini dünya çapında tanıtarak, unutulmalarının önüne geçilmektedir. Türk mutfağında benzer çalışmaların yürütülerek geleneksel tariflerin korunması hedeflenmelidir. Bunun temelinde ise kültürel lezzet öğelerinin ve mutfak kültürünün detaylı olarak tanıtımı göz ardı edilmemelidir. Gastronomi trendlerinden bazıları geleneksel tariflerin çeşitlenmesini ya da geliştirilmesini hedeflerken, bazılarının da geleneksel olarak üretilmesini amaçladığı belirtilmektedir. Bu nedenle, yeni nesil tatlılar olarak ifade edilebilecek olan bu ürünlerin, Türk Mutfağında da zamanla kültürel değere sahip olabileceği söylenebilir.

Yazar Katkısı

Kavramsallaştırma: MCİ; Biçimsel analiz: MCİ; Araştırma: MCİ; Metodoloji: MCİ; Kaynaklar: MCİ; Yazılım: MCİ; Yazım – orijinal taslak: MCİ; Yazım incelemesi ve düzenleme: MCİ

Çıkar Çatışması

Yazar çıkar çatışması olmadığını beyan eder.

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Review Article / Derleme Makale

Regional Distribution of Geographically Indicated Dried Legumes and Dried Legume Dishes in Türkiye

Türkiye'de Coğrafi İşaretli Kuru Baklagiller ve Kuru Baklagil Yemeklerinin Bölgesel Dağılımı

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Abstract

This study aims to identify dry legume products with geographical indications from the seven regions of Türkiye and to analyze the regional distribution of geographically indicated dishes prepared with these legumes. Legumes are known for their environmental sustainability and health benefits and hold a significant place in Turkish culinary culture. Türkiye, with its rich agricultural diversity and deep-rooted gastronomy, hosts numerous local products. Geographical indication (GI) plays a critical role in protecting and promoting these products.

The basic data source for this study is the online database of the Turkish Patent and Trademark Office (TÜRKPATENT), the official authority responsible for the registration of geographical indications and traditional product names in Türkiye. Secondary data were also compiled from domestic and international organizations. Additionally, a literature study was conducted using academic studies obtained from databases such as Google Scholar, Web of Science, and Science Direct, with keywords like "Geographical Indication," "Dry Legumes," and "Legume Dishes." The study analyzed the regional distribution of geographically indicated products and dishes.

The research findings reveal that Türkiye has a total of 24

geographically indicated dry legume products. When examining regional distribution, the Black Sea Region stands out with eight types of dry beans, making it the region with the highest number of geographically indicated legumes. Conversely, the Southeastern Anatolia Region has only one product, the lowest number. There are a total of 72 geographically indicated dishes containing dry legumes, with chickpeas being the most frequently used legume in these dishes. The Southeastern Anatolia Region leads in this category, with 28 geographically indicated dishes.

Geographical indication serves as an essential tool for preserving local products and passing them on to future generations. Considering Türkiye's rich culinary culture and geographical diversity, the promotion of geographically indicated products and dishes holds significant potential for gastronomy tourism. In this context, it is imperative to standardize the production and consumption processes of geographically indicated products and ensure sustainability. Geographical indication can be considered as a strategy that supports both environmental and cultural sustainability.

Özet

Bu çalışma, Türkiye'nin yedi coğrafi bölgesinde coğrafi işaret tesciline sahip kuru baklagil ürünlerini belirlemeyi ve bu baklagillerle hazırlanan coğrafi işaretli yemeklerin bölgesel dağılımını analiz etmeyi amaçlamaktadır. Çevresel sürdürülebilirlikleri ve sağlık açısından faydaları ile bilinen baklagiller, Türk mutfak kültüründe önemli bir yere sahiptir. Zengin tarımsal çeşitliliği ve köklü gastronomik geçmişiyle Türkiye, çok sayıda yerel ürüne ev sahipliği yapmaktadır. Coğrafi işaret (Cİ), bu ürünlerin korunması ve tanıtımı açısından kritik bir rol üstlenmektedir.

Bu çalışmanın temel veri kaynağını, Türkiye'de coğrafi işaretlerin ve geleneksel ürün adlarının tescilinden sorumlu resmi otorite olan Türk Patent ve Marka Kurumu'nun (TÜRKPATENT) çevrim içi veri tabanı oluşturmaktadır. İkincil veriler ise yurt içi ve yurt dışı kuruluşlardan derlenmiştir. Ayrıca, "Coğrafi İşaret," "Kuru Baklagiller" ve "Baklagil Yemekleri" gibi anahtar kelimeler kullanılarak Google Scholar, Web of Science ve Science Direct gibi veri tabanlarından elde edilen akademik çalışmalarla literatür taraması gerçekleştirilmiştir. Çalışmada, coğrafi işaretli ürünlerin ve yemeklerin bölgesel dağılımı incelenmiştir.

Araştırma bulgularına göre, Türkiye genelinde toplam 24 adet coğrafi işaretli kuru baklagil ürünü bulunmaktadır. Bölgesel dağılım incelendiğinde, sekiz farklı kuru fasulye türü ile Karadeniz Bölgesi en fazla coğrafi işaretli baklagil ürününe sahip bölge olarak öne çıkmaktadır. Buna karşılık, yalnızca bir ürüne sahip olan Güneydoğu Anadolu Bölgesi en az sayıya sahip bölgedir. Kuru baklagil içeren coğrafi işaretli yemek sayısı toplamda 72 olup, nohut bu yemeklerde en sık kullanılan baklagil türüdür. Bu kategoride Güneydoğu Anadolu Bölgesi, 28 coğrafi işaretli yemek ile ilk sırada yer almaktadır.

Coğrafi işaret, yerel ürünlerin korunması ve gelecek nesillere aktarılması açısından önemli bir araçtır. Türkiye'nin zengin mutfak kültürü ve coğrafi çeşitliliği dikkate alındığında, coğrafi işaretli ürünlerin ve yemeklerin tanıtımı, gastronomi turizmi açısından büyük bir potansiyel taşımaktadır. Bu bağlamda, coğrafi işaretli ürünlerin üretim ve tüketim süreçlerinin standartlaştırılması ve sürdürülebilirliğinin sağlanması büyük önem arz etmektedir. Coğrafi işaret hem çevresel hem de kültürel sürdürülebilirliği destekleyen bir strateji olarak değerlendirilebilir.

INTRODUCTION

The terms "legume" and "pulse" are frequently used interchangeably, yet they hold distinct meanings. "Legume" refers to plants belonging to the Leguminaceae or Fabaceae family, characterized by their fruit enclosed in a pod. In contrast, "pulse," derived from the Latin word *puls*, specifically denotes dried seeds (1, 2). Legumes are considered the most environmentally sustainable plant species, playing a crucial role in animal nutrition and the prevention of various diseases, including diabetes, heart disease, and cancer (1). In Türkiye, edible legumes rank second only to cereals in human nutrition, with beans, lentils, and chickpeas being the most significant varieties consumed in dry form (3). These legumes are predominantly prepared in stews or similar dishes in Turkish cuisine (4).

Türkiye's rich history and traditional production methods contribute to its abundance of local products (5). Traditional foods hold substantial value for gastronomy tourism, as tourists increasingly seek destinations that preserve

local flavors. To protect these local products and ensure their longevity, legal regulations have been implemented. One such regulation is the geographical indication (5, 6). A geographical indication (GI) denotes a product's place of origin. These indicators, recognized by their place names, signify products with distinctive qualities that are passed down through generations. Local products are identified by their GI emblems (7, 8, 9).

Geographically indicated products have begun to play a significant role in the development of gastronomy tourism (10, 11). From past to present, there has been a noticeable increase in interest and usage of local products, which has also highlighted the growing importance of geographically indicated products. The close interconnection among ecotourism, agrotourism, and gastronomy tourism is conceptually linked to geographical indications as well (11).

In local development initiatives, particularly in the context of gastronomy tourism, geographically indicated products derived from agriculture can be regarded as supportive and complementary elements. Thus, geographical indications emerge as a frequently used tool for fostering local economic development within the framework of gastronomy tourism (12).

This study aims to identify legume products in Türkiye that have received geographical indications and the geographically marked dishes incorporating these products. Given the environmental benefits of legumes and their positive health impacts, this research is significant for gastronomy tourism. It highlights geographically marked legumes and dishes, promoting their prioritization in consumer preferences.

Conceptual Framework

Legumes

Legumes, the seeds of plants in the Leguminaceae family, derive their name from the Latin term "Legumen," which refers to the harvested seeds of podded faba beans (13, 14). Pulses, a subgroup within the legume family, specifically denote dried seeds (1). Mature legume grains are rich in proteins that contain essential amino acids, cellulose, starch, and minerals. Legumes serve as an excellent alternative to animal proteins, often referred to as "the meat of the poor" due to their affordability compared to meat (15, 16). The crude protein content of edible legumes generally exceeds 20%, with an average range of 18-31.6%, varying by variety (17, 18). The nutritional impact of legumes depends not only on the protein quantity but also on the protein quality, influenced by amino acid composition, amino acid imbalance, and amino acid bioavailability (19, 14).

Legumes enhance the physical, chemical, and biological properties of the soil due to the nodosity bacteria in their roots, which increase organic matter and positively affect the yield of subsequent crops (20). These soil benefits are crucial for environmental sustainability and sustainable agriculture (21).

In Türkiye, it is estimated that 1.5 million tons of pure nitrogen-based fertilizers are consumed annually, equivalent to 600,000 tons of pure nitrogen compounds, potentially leading to significant environmental pollution (22). Green fertilization often employs legume and wheatgrass species, such as fodder peas, rape, turnip, grass, rye, and oats (23). The use of mineral nitrogen (especially nitrate) fertilizers in agriculture plays a major role in water and air pollution. It is proposed that incorporating legume plants and using effective bacteria in inoculation could add atmospheric nitrogen to the soil, thereby reducing environmental pollution and conserving energy (23, 24).

The Importance of Legumes in Turkish Culinary Culture

Turkish cuisine is a significant element of Turkish culture. The richness of Turkish culinary heritage is shaped by historical events, geographical conditions, ecological factors, cultural and economic structures, traditions and customs, as well as interactions with other cultures throughout history (25, 26).

Although Turkish cuisine exhibits regional variations, it generally includes a wide array of soups, cereals, meat and vegetable stews, olive

oil dishes, pastries, fried foods, desserts, and traditional beverages (25, 26).

An analysis of Turkish culinary culture from past to present reveals that prominent foods include wheat, bulgur, aşure, keşkek, tarhana, and molasses. Given Anatolia's favorable climate for wheat cultivation, it is noted that dishes incorporating wheat, flour, and bulgur—often combined with various legumes, yogurt, meat, and vegetables—form the foundation of Anatolian Turkish culinary culture (27).

Chickpeas, lentils, and dried beans are the most consumed legume products in Türkiye. In Turkish cuisine, stews made from dried legumes such as chickpeas, dried beans, and lentils are particularly prevalent. Vegetables such as potatoes, carrots, and onions, added during the cooking of legumes, enhance their nutritional value. These legumes play a crucial role in meeting the daily nutritional needs of individuals who do not consume meat dishes. Serving these stews with rice or bulgur pilaf and ayran (a traditional yogurt-based beverage) provides a balanced meal (4, 28, 29).

Local Products and Geographical Indication

In recent years, numerous studies have indicated that tourists with higher levels of education and cultural awareness are increasingly planning their travels around the local characteristics of their destinations, rather than adhering to the traditional holiday concept of the sea-sand-sun trio (30, 31). It has been noted that local food and beverages, along with the presence of renowned restaurants and chefs, play a significant role in shaping these tourists' travel itineraries (32). Local food and products have thus become critical factors in travelers' destination preferences (33). The desire of tourists to taste local dishes and learn about their production methods underscores the importance of local cuisine for both the local populace and gastronomy tourism (34).

Today, countries are making substantial investments in gastronomy tourism, which must be sustainable to provide economic benefits to local communities (35). Local products are pivotal for the sustainability of gastronomy tourism, and maintaining consistent quality, authenticity, and standards of these products is crucial for the sector's development (36, 37).

Türkiye is rich in local products due to its diverse culinary culture, traditional production methods, and variety of agricultural products. These local products, which are closely linked to their regions of origin, are an integral part of the local culture. To protect these products and prevent their imitation, many countries have implemented legal regulations. One such regulation is the geographical indication (5, 38, 9).

Geographical indication has emerged as a primary form of trademark because it conveys information about the origins of products, including their characteristics and the connection between these characteristics and the geographical area (39). The Turkish Patent and Trademark Office (40) defines a geographical indication as "a sign that indicates a product identified with the region, area, or country of origin in terms of distinctive quality, reputation, or other characteristics. When all characteristics of a product originate from the physical and human elements of a specific geographical region, these indications are called 'designations of origin.' The cultivation, processing, and all production stages of such products must occur within the boundaries of a specific geographical area, ensuring strong ties between the product and its region of origin. Geographical indications identified with a specific geographical area due to a particular feature or other qualities, and where at least one of the production, processing, or other stages must be carried out within this area, are termed "geographical indications" (41).

METHODOLOGY

This study aims to identify geographically indicated legume products from Türkiye's seven regions and to analyze the regional distribution of geographically indicated dishes prepared with these products.

The primary data for this study was derived from the online platform of the Turkish Patent and Trademark Office (TÜRKPATENT) (https://ci.turkpatent.gov.tr/), the official authority

responsible for the registration of geographical indications and traditional product names in Türkiye, as well as secondary data collected from domestic and international organizations. Additionally, relevant literature was utilized.

The literature study was conducted using databases such as Google Scholar, Web of Science, and Science Direct. Keywords such as *Geographical Indication*, *Dry Legumes*, and *Legume Dishes* were used to locate both Turkish and English academic studies. The searches focused on academic works examining geographical indications, geographically indicated legumes, and dishes made with legumes.

Dried Legumes with Geographical Indication

An analysis of geographically marked dry legumes in Türkiye reveals a total of 24 products. When categorized by region, the Southeastern Anatolia region has one product, namely the "Mardin Kızıltepe red lentil." The Black Sea region has the highest number of geographically indicated products, with eight varieties, all of which are "Dry beans." Table 1 shows the legumes in Türkiye that have received geographical (42).

Dry beans are cultivated primarily as an affordable protein source, particularly in developing countries, where they contribute to meeting dietary needs, provide economic benefits to rural populations, and are a significant commodity in global trade (43). They are the most widely produced type of edible legumes globally (44).

Despite being introduced to Türkiye after the 17th century, the common bean (*Phaseolus vulgaris L.*) has adapted particularly well to the Black Sea Region. This edible legume crop has demonstrated extensive variation in this region (45).

Dry beans hold a vital place among Türkiye's agricultural lands and products. Although the cultivation area for dry beans fluctuates over the years, their widespread use, agricultural benefits, and established status as a traditional crop among Black Sea Region farmers make them indispensable (46). In the Black Sea Region, beans are a key component of traditional mixed-cropping systems practiced on small plots. This crop has diversified to such an extent that the region has become a micro-gene center for beans (47, 48).

Figure 1. Regional Distribution of Geographically Indicated Dry Legume Products in Türkiye (42)

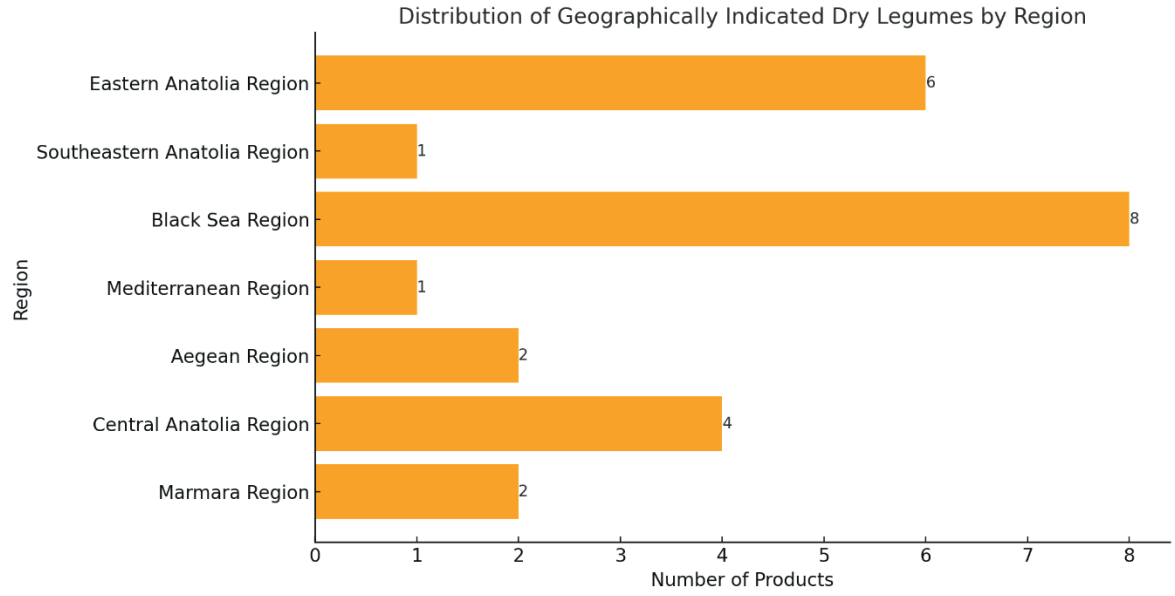

Table 1. Geographical indications for dried legume products in Türkiye (42)

Province/Region	Name of Geographical	Indication Type of Geographical	Indication Date of Registration
Balıkesir/Marmara Region	Manyas Kazak Bean	Protected Designation of Origin	5.07.2023
Bursa/Marmara Region	İnegöl Cerrah Dry Bean	Protected Designation of Origin	7.06.2023
Ankara/Central Anatolia Region	Akyurt Teberik Bean	Protected Designation of Origin	22.12.2023
Konya/Central Anatolia Region	Akçabelen (Çetmi) Sugar Bean	Protected Geographical Indication	29.08.2019
Nevşehir/Central Anatolia Region	Derinkuyu Dry Bean	Protected Geographical Indication	22.11.2021
Sivas/Central Anatolia Region	Suşehri Dry Bean	Protected Designation of Origin	10.06.2022
İzmir/Aegean Region	Çavuşdağı Dry Bean	Protected Designation of Origin	2.08.2021
Denizli/Aegean Region	Çameli Bean	Protected Geographical Indication	27.07.2018
Adana/Mediterranean Region	Tufanbeyli Dry Bean	Protected Designation of Origin	30.01.2023
Bolu/Black Sea Region	Bolu Çivril Bean	Protected Geographical Indication	19.08.2020
Bolu/Black Sea Region	Göynük Bombay Bean	Protected Geographical Indication	2.01.2018
Ordu/Black Sea Region	Akkuş Sugar Bean	Protected Geographical Indication	23.03.2012
Ordu/Black Sea Region	Gürgentepe Shepherd Bean	Protected Designation of Origin	11.11.2022
Giresun/Black Sea Region	Çamoluk Sugar Dry Bean	Protected Geographical Indication	2.05.2018
Bayburt/Black Sea Region	Aydıntepe Sugar Bean	Protected Geographical Indication	9.06.2021
Gümüşhane/Black Sea Region	Gümüşhane Sugar Bean	Protected Geographical Indication	3.12.2019
Gümüşhane/Black Sea Region	Kelkit Sugar Bean	Protected Geographical Indication	2.01.2020
Mardin/Southeastern Anatolia Region	Kızıltepe Red Lentil	Protected Geographical Indication	29.09.2022
Ardahan/Eastern Anatolia Region	Posof Bean	Protected Geographical Indication	23.11.2020
Erzurum/Eastern Anatolia Region	İspir Dry Bean	Protected Geographical Indication	31.01.2011
Erzurum/Eastern Anatolia Region	Narman Sugar Bean	Protected Geographical Indication	20.07.2020
Erzurum/Eastern Anatolia Region	Hınıs Bean	Protected Geographical Indication	27.12.2016
Bingöl/Eastern Anatolia Region	Bingöl Yedisu Horoz Dry Bean	Protected Geographical Indication	12.02.2021
Van/Eastern Anatolia Region	Gevaş Bean	Protected Designation of Origin	13.07.2023

Geographically Signed Dishes Using Dried Legumes

In Türkiye, there are 72 dishes containing dried legumes that have received geographical indications. Analyzing regional differences, the dish with the fewest geographical indications is "Bilecik Bozüyük Lentil Mantı" from the Marmara Region. Conversely, the Southeastern Anatolia Region is the most prominent, with twenty-eight geographically marked dishes featuring dry legumes.

When evaluating the types of legumes incorporated into these dishes, it is found that "kidney beans," "fava beans," and "green beans" are the least frequently used, each appearing in different dishes at least once. In contrast, "chickpea" is the most commonly used legume, featured in 50 different dishes. Table 2 shows the geographically marked dishes containing legumes (42).

The Southeastern Anatolia Region, which boasts twenty-eight geographically indicated dishes containing dry legumes, is characterized by local products derived from grains, legumes, olives, pistachios, vegetables, and fruits cultivated on its fertile lands (49). The cuisines of all provinces in this region exhibit similarities. The foundation of these dishes consists of meat, wheat products, legumes, and vegetables. In Southeastern Anatolian cuisine, after meat, the most commonly used legumes are chickpeas and lentils (50).

When examining the use of dry legumes and oilseeds in soups within the regional cuisine, chickpeas and lentils are found to have the highest usage rates, while in main courses, chickpeas are the most frequently used product (51).

Figure 2. Regional Distribution of Dishes Made with Geographically Indicated Dry Legumes in Türkiye (42)

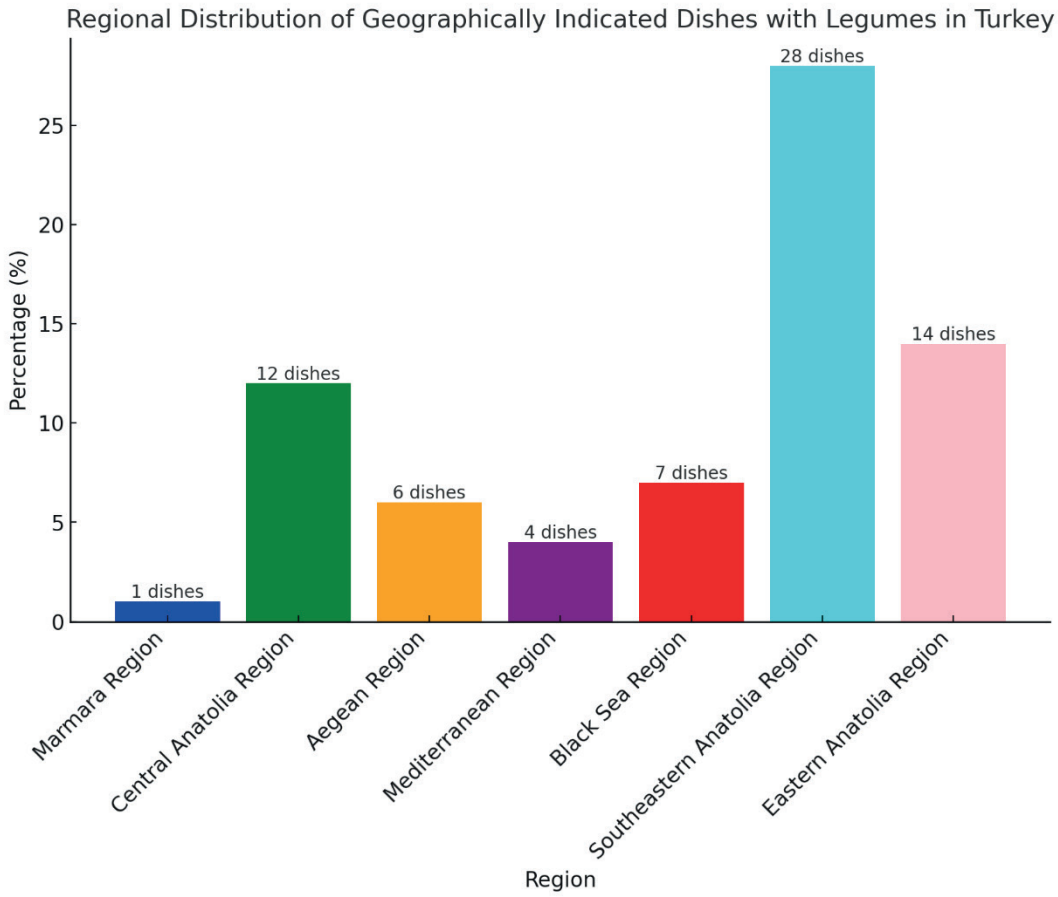

Table 2. Geographical indications for legume-containing dishes (42)

Province/Region	Geographical Indication Name	Product/Product Group	Type of Geographical Indication	Registration Date	Contained Dried Legume(s)
Bilecik/Marmara Region	Bozüyük Lentil Mantı	Mantı / Meals and soups	Protected Designation of Origin	27.07.2020	Kayı-91 variety green lentils grown in Bilecik
Konya/Central Anatolia Region	Konya Tandoor Soup	Soup / Meals and soups	Protected Designation of Origin	18.05.2022	Contains chickpeas, lentils, and kidney beans
Konya/Central Anatolia Region	Konya Ovmaç Soup	Soup / Meals and soups	Protected Designation of Origin	4.10.2021	Contains green lentils
Konya/Central Anatolia Region	Konya Topalağı	Meal / Meals and soups	Protected Designation of Origin	25.08.2022	Contains chickpeas
Konya/Central Anatolia Region	Konya Kıtırlı Mantı	Mantı / Meals and soups	Protected Designation of Origin	1.10.2021	Contains green lentils
Konya/Central Anatolia Region	Konya Sour Squash	Meal / Meals and soups	Protected Designation of Origin	20.01.2022	Contains chickpeas
Ankara/Central Anatolia Region	Akyurt Cold Soup	Soup / Meals and soups	Protected Designation of Origin	2.03.2022	Contains chickpeas and kidney beans
Ankara/Central Anatolia Region	Akyurt Tutmaç Soup	Soup / Meals and soups	Protected Designation of Origin	2.03.2022	Contains green lentils
Çankırı/Central Anatolia Region	Çankırı Tutmaç Soup	Soup / Meals and soups	Protected Designation of Origin	1.06.2021	Contains green lentils
Kayseri/Central Anatolia Region	Kayseri Kurşun Aşı Soup	Soup / Meals and soups	Protected Designation of Origin	22.11.2021	Contains green lentils and chickpeas
Kırşehir/Central Anatolia Region	Kırşehir Çirleme Meal	Meal / Meals and soups	Protected Designation of Origin	15.11.2021	Contains chickpeas
Sivas/Central Anatolia Region	Divriği Rice / Alatlı Rice Pilaf	Pilaf / Meals and soups	Protected Designation of Origin	9.10.2020	Contains boiled chickpeas
Karaman/Central Anatolia Region	Karaman Şebit Pilaf	Pilaf / Meals and soups	Protected Designation of Origin	7.09.2023	Contains chickpeas
Mersin/ Mediterranean	Tarsus Hummus	Hummus / Meals and soups	Protected Geographical Indication	1.11.2017	Cooked chickpeas
Isparta/ Mediterranean	Isparta Kabune Pilaf	Pilaf / Meals	Protected Geographical Indication	30.05.2018	Contains chickpeas grown in Isparta

Antalya/ Mediterranean	Alanya Gülüklü (Hülüklü) Soup	Soup / Meals and soups	Protected Geographical Indication	26.09.2019	Contains chickpeas
Kahramanmaraş/ Mediterranean	Maraş Sour Soup	Soup / Meals and soups	Protected Geographical Indication	15.06.2023	The soup contains lentils and chickpeas
Çorum/Black Sea	Alaca Yarma Meal	Meal / Meals and soups	Protected Geographical Indication	22.11.2023	Contains chickpeas and kidney beans
Amasya/Black Sea	Amasya Stuffed Dolma	Meal / Meals and soups	Protected Geographical Indication	17.08.2021	Contains dried fava beans
Amasya/Black Sea	Amasya Toyga Soup	Soup / Meals and soups	Protected Geographical Indication	1.12.2021	Contains chickpeas
Rize/Black Sea	Çayeli Bean Stew	Meal / Meals and soups	Protected Geographical Indication	2.01.2018	The dish contains a type of large-seed white bean described as "sugar"
Bayburt/Black Sea	Bayburt Black Beetroot Dish	Meal / Meals and soups	Protected Geographical Indication	18.02.2021	Contains green lentils
Düzce/Black Sea	Yufkalı Konuralp Pilaf	Pilaf / Meals	Protected Geographical Indication	7.05.2021	Contains chickpeas
Ordu/Black Sea	Ordu Beetroot Soup / Ordu Cabbage Soup	Soup / Meals and soups	Protected Geographical Indication	16.08.2023	Contains cooked cranberry beans
Diyarbakır/ Southeastern Anatolia	Diyarbakır Habenisk Soup	Soup / Meals and soups	Protected Geographical Indication	11.05.2022	Contains green lentils and chickpeas
Diyarbakır/ Southeastern Anatolia	Diyarbakır Hedik Dish	Meal / Meals and soups	Protected Geographical Indication	11.05.2022	Contains chickpeas
Diyarbakır/ Southeastern Anatolia	Diyarbakır Gendüme Meal	Meal / Meals and soups	Protected Geographical Indication	11.05.2022	Contains mung beans
Diyarbakır/ Southeastern Anatolia	Diyarbakır Lebeni Soup	Meal / Meals and soups	Protected Geographical Indication	11.10.2021	Contains chickpeas
Diyarbakır/ Southeastern Anatolia	Diyarbakır Nardan Meal	Meal / Meals and soups	Protected Geographical Indication	10.03.2022	Contains chickpeas
Gaziantep/ Southeastern Anatolia	Gaziantep Malhıtalı Meatball	Lentil meatball / Meals and soups	Protected Geographical Indication	9.02.2021	Contains red lentils, named "malhıta" in Gaziantep

Gaziantep/ Southeastern Anatolia	Gaziantep Chickpea Wrap / Antep Chickpea Wrap	Chickpea Wrap / Meals and soups	Protected Geographical Indication	17.12.2020	The wrap contains chickpeas with large, light yellow grains, known as "koçbaşı"
Gaziantep/ Southeastern Anatolia	Antep Rolled Meatball	Meal / Meals and soups	Protected Geographical Indication	13.01.2017	Contains chickpeas
Gaziantep/ Southeastern Anatolia	Gaziantep Şiveydiz Meal	Şiveydiz / Meals and soups	Protected Geographical Indication	15.03.2018	Contains chickpeas
Gaziantep/ Southeastern Anatolia	Gaziantep Sour Potato / Antep Sour Potato	Meal / Meals and soups	Protected Geographical Indication	15.05.2021	Contains chickpeas
Gaziantep/ Southeastern Anatolia	Gaziantep Yogurt Potato / Antep Yogurt Potato	Meal / Meals and soups	Protected Geographical Indication	15.05.2021	Contains chickpeas
Gaziantep/ Southeastern Anatolia	Gaziantep Yogurt Green Beans / Antep Yogurt Green Beans	Meal / Meals and soups	Protected Geographical Indication	10.02.2022	Contains chickpeas
Gaziantep/ Southeastern Anatolia	Gaziantep Flatbread Soup / Antep Flatbread Soup	Soup / Meals and soups	Protected Geographical Indication	2.07.2021	Contains chickpeas
Gaziantep/ Southeastern Anatolia	Gaziantep Beef with Chickpeas / Antep Beef with Chickpeas	Meal / Meals and soups	Protected Geographical Indication	15.05.2021	Contains chickpeas
Gaziantep/ Southeastern Anatolia	Gaziantep Mash Soup / Antep Mash Soup	Soup / Meals and soups	Protected Geographical Indication	7.03.2022	Contains mung beans
Gaziantep/ Southeastern Anatolia	Gaziantep Mash Salad / Antep Mash Salad	Meal / Meals and soups	Protected Geographical Indication	2.09.2021	Contains mung beans
Gaziantep/ Southeastern Anatolia	Gaziantep Cauldron Soup / Antep Cauldron Soup	Soup / Meals and soups	Protected Geographical Indication	24.01.2022	Contains chickpeas
Kilis/Southeastern Anatolia	Kilis Şıhılmahşe	Stuffed vegetable / Meals and soups	Protected Geographical Indication	26.09.2022	Onions stuffed with cooked chickpeas
Şanlıurfa/ Southeastern Anatolia	Urfa (Şanlıurfa) Squash Dish	Meal / Meals and soups	Protected Geographical Indication	21.02.2018	Contains chickpeas
Şanlıurfa/ Southeastern Anatolia	Urfa (Şanlıurfa) Borani with Chard / Borani with Chard	Meal / Meals and soups	Protected Geographical Indication	29.12.2017	Contains chickpeas and mung beans

Şanlıurfa/ Southeastern Anatolia	Şanlıurfa Stuffed Mung Bean Wrap / Şanlıurfa Stuffed Mung Bean Wrap	Meal / Meals and soups	Protected Geographical Indication	9.06.2023	Contains mung beans
Şanlıurfa/ Southeastern Anatolia	Urfa (Şanlıurfa) Lebeni Soup	Soup / Meals and soups	Protected Geographical Indication	29.12.2017	Contains chickpeas
Malatya/Eastern Anatolia Region	Malatya Analı Kızlı Meatball / Malatya Tiritli Meatball	Dish / Dishes and Soups	Geographical Indication Mark	24.09.2021	Boiled chickpeas are included in Malatya Analı Kızlı Meatball / Malatya Tiritli Meatball.
Malatya/Eastern Anatolia Region	Malatya Cold Soup with Ayran	Dishes and Soups	Geographical Indication Mark	29.05.2023	Boiled chickpeas are included in Malatya Cold Soup with Ayran.
Malatya/Eastern Anatolia Region	Malatya Hırçikli Meatball	Dish / Dishes and Soups	Geographical Indication Mark	31.08.2023	Black lentils are included in Malatya Hırçikli Meatball
Iğdır/Eastern Anatolia Region	Iğdır Bozbaş Meal	Dish / Dishes and Soups	Geographical Indication Mark	2.07.2021	Chickpeas are included in Iğdır Bozbaş Meal.
Iğdır/Eastern Anatolia Region	Iğdır Omaç Soup	Dishes and Soups	Geographical Indication Mark	26.08.2021	Black-eyed peas (specifically the karnıkara variety) are included in Iğdır Omaç Soup.
Iğdır/Eastern Anatolia Region	Iğdır Stone Meatball	Dish / Dishes and Soups	Geographical Indication Mark	14.12.2017	Split chickpeas are included in Iğdır Stone Meatball.
Van/Eastern Anatolia Region	Van Sengeser	Dish / Dishes and Soups	Geographical Indication Mark	26.11.2021	Boiled green lentils are included in Van Sengeser.
Van/Eastern Anatolia Region	Van Keledoş	Local Dish	Geographical Indication Mark	8.11.2017	Boiled chickpeas and green lentils are included in Van Keledoş.
Hakkari/Eastern Anatolia Region	Gayle Zengil	Dish / Dishes and Soups	Geographical Indication Mark	15.11.2023	Chickpeas are included in Gayle Zengil.

Hakkari/Eastern Anatolia Region	Hakkari Girara Huluga	Dish / Dishes and Soups	Geographical Indication Mark	11.01.2023	Chickpeas are included in Hakkari Girara Huluga.
Hakkari/Eastern Anatolia Region	Hakkari Kepaye	Dish / Dishes and Soups	Geographical Indication Mark	11.01.2023	Boiled chickpeas are included in Hakkari Kepaye.
Hakkari/Eastern Anatolia Region	Hakkari Kıris	Dish / Dishes and Soups	Geographical Indication Mark	19.12.2017	Chickpeas are included in Hakkari Kıris.
Erzurum/Eastern Anatolia Region	Erzurum Kara Fatma Soup	Dish / Dishes and Soups	Geographical Indication Mark	8.12.2022	Chickpeas and green lentils are included in Erzurum Kara Fatma Soup.
Tunceli/Eastern Anatolia Region	Tunceli Şorbik Soup	Dish / Dishes and Soups	Geographical Indication Mark	18.12.2017	Chickpeas are included in Tunceli Şorbik Soup.

CONCLUSION, DISCUSSION, AND RECOMMENDATIONS

The findings of the study reveal the regional distribution diversity of geographically indicated dry legumes in Türkiye. While the Black Sea Region has the highest number of geographically indicated dry legumes, the Southeastern Anatolia Region leads in the number of dishes containing these legumes. Our research identified 24 geographically indicated dry legumes and 72 geographically indicated dishes containing dry legumes across Türkiye's seven regions and 81 provinces.

Türkiye's geographical location and rich culinary heritage provide significant potential for geographically indicated products and dishes. Each region and city holds unique cultural elements, underscoring the importance of preserving and promoting these values. For example, Bolat et al. (2017) highlighted that challenges in legume production, such as high production costs, unstable agricultural policies, and lack of organization, can be mitigated through improved producer organization and targeted support mechanisms (43). However, during the literature study, no studies were found specifically focusing on geographically indicated legume products and the dishes prepared with them. Nevertheless, Yağmur and Kardeş (2023) examined national trends and the associations of the concept of geographical indications in their study, "An Examination of Studies Conducted in the National Literature on the Concept of Geographical Indication."(52). Çağlı (2012) analyzed the regional distribution of registered geographically indicated products, highlighting the prominence of Southeastern Anatolia in this regard (53). Additionally, Verza et al. (2024) analyzed market dynamics for lentils in Italy, emphasizing the growing consumer demand for sustainable and regionally distinctive products (54).

Geographically indicated products in Türkiye have substantial potential to contribute to rural development. To realize this potential, local producers should be encouraged to engage in promotional and marketing activities that highlight the geographical connections of their products. Furthermore, regional education programs should be implemented to raise awareness among producers about maintaining these connections sustainably. Future research could focus on the economic impact of these

products, their contribution to regional development, and their role in sustainable agriculture. Additionally, topics such as consumer interest in geographically indicated products and their role in local markets and exports could be explored.

In conclusion, Türkiye holds vast potential for preserving local culture and supporting rural development. Developing comprehensive policies inspired by international examples would be a critical step in promoting and utilizing this potential in broader markets.

Conflict of interest

All authors declared that they have no conflict of interest.

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Review Article / Derleme Makale

Potential use of food wastes in functional foods: A review of microbial safety studies

Gıda atıklarının fonksiyonel gıdalarda potansiyel kullanımı: mikrobiyal güvenlik çalışmalarının bir derlemesi

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Abstract

This review aims to provide an overview of the potential use of food waste in the production of functional foods, focusing on the microbiological safety of food waste. Food is an essential human need, but food waste has become a significant global issue. Effective management, treatment, and recovery of food waste is key to address this challenge. There is now considerable interest in recycling and upgrading food waste. A variety of methods have been developed to effectively control and use these wastes, including the extraction of bioactive compounds from the waste for reintroduction into the food chain. In this context, the study reviewed recent research identified through the keywords "food waste," "functional food," and "food safety." This review examines the role of food waste in functional food development, highlighting both its advantages and the microbiological risks. The findings highlight that food waste from many food industries is considered a cheap source of functional or bioactive compounds. Sugars, proteins, lipids, fibers, vitamins, minerals, and pigments are the main value-added products derived from fruit and vegetable waste. Animal waste contains bioactive peptides from meat and dairy products. The aforementioned ingredients can be transformed into nutraceuticals and functional foods by reintroducing them into the food chain as natural food additives. The

review concludes that these natural compounds have the potential to enhance the safety and palatability of foods, while simultaneously addressing any underlying nutritional deficiencies. However, the reintroduction of food wastes into the food chain or food matrices requires a comprehensive evaluation of the optimal recycling and manufacturing practices to ascertain their suitability and safety. Although many food wastes are valorized, few studies have focused on microbiological safety assessments, an important concern that must be addressed to ensure the safety of food products.

Özet

Bu derleme, fonksiyonel gıdaların üretiminde gıda atıklarının potansiyel kullanımına genel bir bakış sunmayı amaçlamakta ve özellikle gıda atıklarının mikrobiyolojik güvenliğine odaklanmaktadır. Gıda, insan yaşamı için temel bir ihtiyaçtır; ancak gıda israfı günümüzde önemli bir küresel sorun haline gelmiştir. Bu sorunun çözümünde gıda atıklarının etkili yönetimi, işlenmesi ve geri kazanımı büyük önem taşımaktadır. Gıda atıklarının geri dönüştürülmesi ve değerlendirilmesine yönelik ilgi son yıllarda artmıştır. Bu atıkların kontrol altına alınması ve yeniden kullanılması için çeşitli yöntemler geliştirilmiştir; bunlar arasında, gıda zincirine yeniden kazandırılmak üzere atıklardan biyoaktif bileşiklerin ekstraksiyonu yer almaktadır. Bu bağlamda, çalışmada "gıda atığı", "fonksiyonel gıda" ve "gıda güvenilirliği" anahtar kelimeleri kullanılarak yapılan güncel araştırmalar gözden geçirilmiştir. Bu derleme, fonksiyonel gıda geliştirilmesinde gıda atıklarının rolünü incelemekte, avantajlarını ve mikrobiyolojik risklerini ortaya koymaktadır.

Elde edilen bulgular, birçok gıda endüstrisinden kaynaklanan atıkların, fonksiyonel ya da biyoaktif bileşiklerin ucuz bir kaynağı olarak değerlendirildiğini göstermektedir. Meyve ve sebze atıklarından elde edilen şekerler, proteinler, lipidler, lifler, vitaminler, mineraller ve pigmentler, başlıca katma değerli ürünler arasında yer almaktadır. Hayvansal atıklar ise et ve süt ürünlerinden elde edilen biyoaktif peptitleri içermektedir. Bu bileşenler, doğal gıda katkı maddeleri olarak gıda zincirine yeniden kazandırılarak nutrasötik ve fonksiyonel gıdalara dönüştürülebilir. Derlemede, bu doğal bileşiklerin, gıdaların güvenilirliğini ve tat kabul edilebilirliğini artırma potansiyeline sahip olduğu, aynı zamanda besin eksikliklerini giderme konusunda da katkı sağlayabileceği belirtilmektedir. Bununla birlikte, gıda atıklarının gıda zincirine veya gıda matrislerine yeniden kazandırılması sürecinde, bu bileşenlerin uygunluğu ve güvenliği açısından optimum geri dönüşüm ve üretim uygulamalarının kapsamlı bir şekilde değerlendirilmesi gerekmektedir. Birçok gıda atığının değerlendirilmesine rağmen, mikrobiyolojik güvenlik değerlendirmelerine odaklanan çalışmalar sınırlıdır. Bu durum, gıda ürünlerinin güvenilirliğinin sağlanması açısından ele alınması gereken önemli bir konudur.

INTRODUCTİON

Recently, people have become more concerned about food safety and sustainability. Factors contributing to this situation include population growth, climate change, water scarcity, farmer distress, and food waste. It is estimated that by 2050, the global population will reach 9 billion, necessitating an increase in food production to meet the demands of this growing population. Furthermore, it is estimated that the global food demand will be 60% higher than it is today. Successful resolution of this challenge will ensure the sustainability of food.

A review of the literature revealed that approximately one-third of all food is lost or wasted as a consequence of various unsustainable practices (1). The terms "food waste" and "food loss" are often used interchangeably, but the concepts are different (2, 3). The term "food loss" refers to the reduction in the quantity or quality of food that can be attributed to the decisions and actions of food suppliers along the supply chain before reaching the consumer. Conversely, food waste refers to the reduction in the quantity or quality of food resulting from the decisions and actions of consumers, retailers, and food services (4). From the initial production stage to the final stage of consumption, over 58 million tons of food waste are generated annually (2), with an estimated market value of 132 billion euros (5). In relation to specific food types, roots, tubers, and oleaginous crops exhibited the highest incidence of losses, amounting to 25% from the post-harvest stage to the distribution stage. Subsequently, fruit and vegetables (30%), meat

and animal products (12%), and cereals and pulses (9%) were identified as the most affected food types (6, 7).

The reduction of food loss and waste represents a pivotal strategy for enhancing the efficacy of food system, reducing production costs, and advancing environmental sustainability (8). The conventional method for addressing food waste is incineration or disposal in landfills. However, the incineration or disposal of food waste can result in contamination of the air, water, and soil, as well as of food. In light of these considerations, the European Union (EU) is encouraging a reduction in food waste and exploring novel applications of using food wastes to address these issues, apart from the aforementioned applications. In this context, various techniques have been employed for the efficient utilisation of waste. Such methods include the extraction of essential nutrients from waste, its use as an additive in functional food production, and its use as a raw material for fermentation.

Recent studies have demonstrated that food waste derived from a range of food sectors, including vegetables, fruits, drinks, meat, aquaculture, and marine foods, represents an interesting and potentially cost-effective source of useful or bioactive substances for functional food production (9). The utilisation of bioactive chemicals recovered from food supply chain wastes as new products or raw materials through sustainable extraction technologies will have a beneficial impact on human health, thereby stimulating the development of new value-added companies. Conversely, the reintroduction of recovered food waste biocompounds presents some challenges, including safety, biological instability and the potential for contamination by pathogens or toxins. Consequently, these substances must be regarded as novel foods and undergo safety assessments that may differ according to the existing legislation in other countries concerning the use of food waste (10). The aim of this review is to provide an overview of the potential of food waste in the production of functional foods, with a particular focus on their microbiological safety. This study also examined whether microbial safety assessments have been conducted on these bioactive compounds during their reintroduction into the food chain.

METHOD

In this paper, a literature review was conducted using the following keywords: food waste, functional foods, and food safety. The objective of this study was to examine the literature on the use of food waste in functional food production, with a particular emphasis on microbial safety considerations.

Food Wastes

The Food and Agriculture Organization (FAO) (4) stated that food waste is increasing at similar rates in both developed and developing countries. Products made from food waste have high market potential because they are inexpensive, abundant, and easily accessible. Additionally, food waste contains health-promoting substances, further enhancing the market value of waste-derived products. Fig. 1 presents the food waste types.

Potential Use of Food Wastes in Functional Food Production

Fruit and vegetables wastes

The consumption of fruits and vegetables contributes to the maintanence of nutritional well-being. In this context, fruit and vegetable production has increased in response to population growth and shifts in dietary patterns. The most commonly produced fruits are apples, bananas, citrus fruits, grapes, melons, and pears. The most commonly produced vegetables are brassicas, cucumbers, cabbages, cauliflower, garlic, tomatoes, onions, carrots, and turnips (11). However, most vegetables and fruits are lost or wasted during the post-harvest period due to their susceptibility to microbiological degradation. A significant amount of waste is produced following the extraction of juice or the production of value-added products such as jams, jellies, and marmalades. The majority of this waste is in the form of pomace, a mixture of pulp, peel, seeds, and stalks, which often have a higher concentration of bioactive chemicals than the actual fruit juice. Conversely, the industrial

processing of common crops such as potatoes, tomatoes, and carrots results, in the generation of considerable quantities of waste (12). Table 1 presents examples of the fruit and vegetable wastes.

As previously stated, by-products or wastes from fruits and vegetables can be used as innovative ingredients or food fortifiers because of their high bioactive content. To extract bioactive components, traditional extraction methods use chemicals or solvents with the objective of lysing or disrupting the cells or tissues of interest. Such procedures include acid, alkali, and solvent extraction. Furthermore, the use of the significant amounts of chemicals necessary for these processes inevitably has an unsustainable environmental impact. Alternative extraction techniques include ultrasound-assisted extraction, microwave-assisted extraction, accelerated solvent extraction, pulse electric field, high-pressure processing, and colloidal gas aphrons, as well as subcritical and supercritical fluid extraction. These processes can be used separately, as a preliminary step, or in combination with one another to achieve the highest yield and lowest cost (13).

Because of their wide range of possible applications in various industrial sectors, fruit and vegetable wastes can contribute to circular economy. Implementing improved waste management strategies is a key aspect of the transition to a bioeconomy, with the aim of reducing the negative environmental impacts associated with the fruit and vegetable processing

Fig. 1. Food waste types

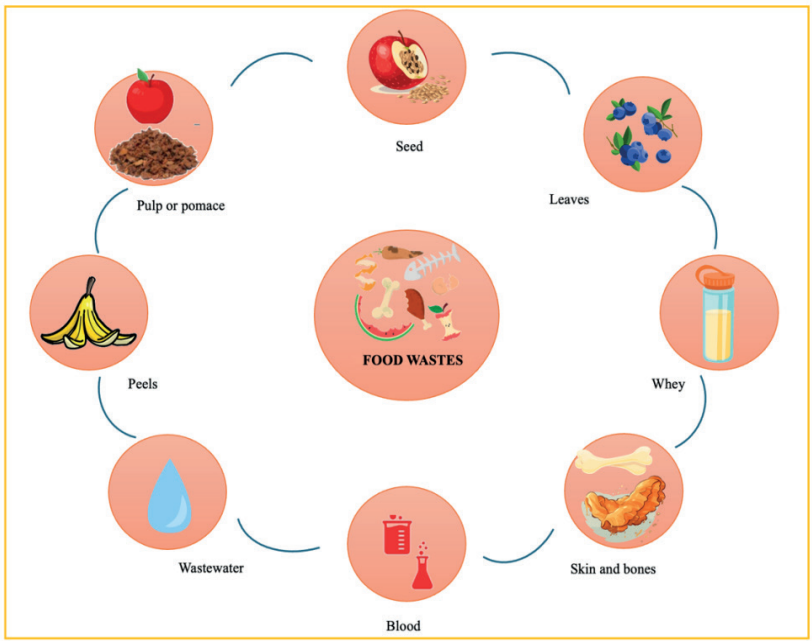

Table 1. Parts of some fruit and vegetable wastes [(Adapted from Kainat et al. (13)]

Fruit and vegetables	Wastes	References
Apple	Pomace, peel, and seeds	
Banana	Peel	
Grapes	Skin, stem, seeds, and pomace	
Orange	Peel	(14)
Onion	Outer leaves	
Tomato	Core, skin, and seeds	
Potato	Peel	
Lemon	Peel and seeds	

industry. Therefore, there is a common interest in discovering innovative strategies for valorizing these substrates. Further innovative valorisation strategies aim to recover high-value ingredients from fruit and vegetable waste, which are used as natural sources of biologically active substances for the formulation of functional foods. As previously stated, the most common way to use waste is to extract useful bioactive substances. Another current strategy is to use them in fermentation (15). Table 2 presents the use of fruit and vegetable waste in different food products, such as bakery foods, meats, snacks, and beverages, as well as their use as prebiotic compounds.

Table 2. Food waste valorisation studies

Food waste	Aim	Results	References
Pineapple peel	Cracker production	Nutritionally enhanced and sensory-acceptable crackers	(16)
Tomato waste	Juice production	Antioxidant capacity against free radicals	(17)
Broccoli pomace	Juice production	High antioxidant activity, higher soluble carbohydrates (lower fiber content) and, high protein content	(18)
Pineapple peels	Fermentation by *Trichoderma viride*	Pineapple peels with *T. viride* produced high protein fungal biomass	(19)
Sea buckthorn waste	Refreshing beverage production using *Saccharomyces cerevisiae*	Enhanced antioxidant, antimicrobial, and nutritional properties	(20)
Mandarin/ orange waste	Fermentation by *Clostridium beijerinckii*	*C. beijerinckii* **produced 0.046 g** of butanol per 1 g of dried strained lees in the culture supernatant	(21)
Orange peel	Wheat dough and bread production	Orange peel powder strengthened the dough elasticity. Wheat dough was changed by affecting the fibre, pectin and polyphenol components	(40)
Jackfruit peel	Cookie production	Jackfruit peel flour significantly affected the sensory, physical and chemical attributes of the cookies	(41)
Mango, apple and banana peels	Prebiotic effect examination	Apple, banana, and mango peel powder (2%) can be used as prebiotics to enhance the growth of lactic acid bacteria	(47)
Apple peel	Cereal-based muffin and apple puree production	The total phenolic content, dietary fiber content, total antioxidant activity, and anti-hyperglycemic properties increased with the incorporation of apple peel powder, specifically in muffin	(48)
Melon peel powder	Functional yoghurt production	Melon peel powder exhibited prebiotic effect and enhanced antioxidant activity. Yoghurt containing 2% melon peel powder had the highest taste and sensory qualities	(49)
Apple pomace	Baked pork production	The use of 0.5% freeze-dried apple pomace was most effective in inhibiting lipid oxidative changes in baked pork	(50)

There are several advantages to the use of fruit and vegetable waste in innovative food formulations. Table 2 presents the extensive research conducted to develop functional foods with enhanced antioxidant activity, nutritional value, and sensory properties using waste. These studies have shown that fruit and vegetable waste can significantly enhance the physicochemical, sensory, nutritional, and bioactive properties of the final products. Nevertheless, in addition to these studies, conducting microbial safety assessments is essential to ensure public health and sustainability.

Dairy industry wastes

The primary source of waste produced following the processing of animal products is the dairy and meat processing industries (12). The dairy industry plays an essential role in the global food industry by providing a range of products that meet the nutritional needs of a vast consumer base. These products include milk, cheese, butter, ghee, and milk powder (23, 42). In 2019, global milk production reached 852 million tons, increasing to 906 million tons in 2020. By 2030, production is predicted to increase by 1.7% per year, reaching 1.020 million tons (22). A range of materials, including proteins, sugars, fats, food additives and cleaning agents, are produced as waste products during dairy processing and are discharged into effluents or sludge. In this context, dairy waste can be broadly categorised into two main types: waste water (effluent) and solid waste. The dairy effluent is characterised by a high organic matter content, which is conducive to the microorganisms growth. This, in turn, enables the production of a range of valuable products via microbial activity. However, the primary waste product of cheese production is whey, which is a significant component of dairy effluent. This effluent contains a substantial source of protein and, through enzymatic hydrolysis, can serve a source of bioactive peptides (24). For instance, the use of hydrolysed whey based medium fermented by LAB as a preservative in bread preparation represents a valuable opportunity to use a natural antifungal agent (25). In their study, they found that using a fermented whey medium for dough preparation resulted in a 0.5–0.6 log CFU/g reduction in *Penicillium expansum* growth and an improvement in the shelf life of 1–2 days in relation to control bread.

The most common methods of treating dairy waste include physicochemical and biological. However, the cost-effectiveness and environmentally friendly nature of biological methods make them a preferred option over physicochemical techniques. On the other hand, the conversion of dairy waste into value-added products aligns with European policies that promote a circular economy and encourage the reduction of waste and sustainable production practices (42). Dairy waste is rich in organic

Table 3. Dairy waste valorisation studies

Waste	Aim	Results	References
Ricotta cheese whey	Sports beverage	Increased vitamin, mineral, antioxidant, and total phenolic compound content	(26)
Sweet cheese whey	Growth medium	Novel strategy for cultivating selected starters with a bio-protective activity by valorizing cheese whey	(27)
Powder whey	Fruit beverage	Angiotensin-converting enzyme inhibitory activity, antioxidant activity, and α-glucosidase inhibition	(28)
Whey protein concentrate	Cookie	Increased protein and mineral content and reduced carbohydrate and calorie intake	(43)

matter and can therefore be used as a substrate for the production of functional foods. Table 3 summarizes studies on the valorization of dairy waste.

As shown in Table 3, whey is a by-product of the dairy industry and is a widely used ingredient in the production of various functional products. Therefore, dairy waste can be used to produce value-added foods, thus supporting a circular economy and reducing the environmental impact of waste disposal.

Meat industry wastes

The livestock slaughtering and meat processing industries represent a significant sector of the food industry. It continues to grow in response to the need to sustain a growing global population with diverse nutritional requirements. Pork, beef, and poultry production has doubled in the last decade and is expected to continue rising until 2050 (44). The world's meat production was around 360 million tons (carcass weight equivalent) in 2022 (45) and is expected to increase by almost 44 million tons by 2030 (46). Meat industry wastes, including horns, blood, bones, skin, and guts, are rich in proteins that can be incorporated into diets. They also include antimicrobial and antioxidant properties associated with hydrolysed peptides. These properties can be effective in extending the shelf life of food (29). Protein-rich meat waste is an attractive material for the production of bioactive peptides with health-promoting properties. A water-insoluble collagen is subjected to hydrolysis under strictly controlled conditions to form gelatin, which can be incorporated into a diverse range of food products. It is a major ingredient in aspic and jelly. In contrast, collagen derived from hides and skins acts as an emulsifier in meat products (30). However, edible fats from meat can be used in bakeries for cooking and frying, and to improve the flavour and texture of foods (31).

The use of bioactive peptides derived from meat industry waste or byproducts with beneficial physiological effects is a promising option for the development of functional foods. It is noteworthy that limited studies have been conducted on the product development and effects of foods with added bioactive peptides. Further research is needed to investigate the improved processing, sensory evaluation, and health benefits of using bioactive peptides from the meat industry as ingredients in functional foods. However, although meat industry wastes could be an important source of nutrients, their safety needs to be investigated (35).

Table 4. Meat industry waste valorisation studies

Product	Waste	Results	References
Nuggets	Chicken and beef liver	**Enhanced nutritional profile of processed foods**	(32)
Forcemeat	Chicken feet and head	Enhanced physical and chemical properties, cost-effective, sustainable	(33)
Yoghurt	Gelatin extracted from bovine heart	The addition of 1.5% gelatin considerably affected the physicohemical properties and texture of the final product	(34)
Sausages	Collagen gel extracted from chicken feet	Collagen-based fat reduction reduced thiobarbituric acid reactive substance levels, with the collagen gel sample showing better antioxidant activity and lower atherogenicity and thrombogenicity indices compared to the hydrolyzed collagen sausage	(51)

Microbial Safety of Food Wastes

The issue of food safety, that is, the assurance that food will not cause harm to the consumer when it is prepared and consumed according to its intended use, remains a significant global concern that affects the health of populations in both industrialised and developing countries. In this context, consumers continue to demand fresh and processed foods that are safe to eat, convenient to consume, promote health and well-being, and have high sensory qualities. Another growing consumer demand is that food products should be produced in an environmentally sustainable way. Food loss and waste are critical issues that impact both food safety and environmental sustainability. Reducing food waste has emerged as a key strategy to ensure food security, minimize environmental impact, and produce sustainable foods.

The recycling and upgrading of food waste, in accordance with the EU Circular Economy Action Plan and European Bioeconomy Strategy, is currently a highly popular approach. As previously stated, this involves the utilisation of valorised waste in a diverse range of applications across various industries, which stimulates the growth of the food sector, increases commercial outputs, and prevents issues associated with improper waste management and its detrimental impacts on the environment.

The most prevalent pollutants in wastes are pesticides, biogenic amines, mycotoxins, pathogens, and heavy metals, despite the obvious benefits of this strategy. All these hazards can cause serious illness; therefore, several factors need to be considered when validating the suitability of food waste for extracting valuable constituents.

Food waste can be stored for several days or weeks when collected, sorted and transported prior to final treatment, and is easily spoiled due to its high organic matter and water content. The presence of pathogens in spoiled food waste is a common occurrence, given that such waste contains biodegradable components that can facilitate the growth of pathogens (Table 5) (56). *Salmonella*, *E. coli* and *Listeria monocytogenes* are the most common foodborne pathogens detected in food wastes (57). Therefore, pathogens are important as the reintroduction of contaminated waste could result in numerous foodborne outbreaks (6).

Pathogen contamination in food waste is typically the result of inadequate hygiene conditions during the production, transportation and storage of the waste. Furthermore, the risk of cross-contamination during the handling and processing of the waste is also considerable. Therefore, the reintroduction of wastes into the food chain necessitates a thorough assessment of the optimal manufacturing and recycling procedures to ensure their microbial safety (10). In the context of functional food production, it is important to assess and reduce pathogen contamination in food waste. This can be achieved through the pre-treatment of wastes using a combination of physical, chemical and biological methods, which effectively reduce the pathogen count. Additionally, microbial safety analyses in accordance with international standards are essential for the safe reuse of wastes.

Table 5. Presence of pathogens in food waste

Food wastes	Potential pathogens	References
Fruit and vegetable wastes	*Salmonella* spp. *E. coli* O157:H7, *L. monocytogenes*	(58)
Dairy wastes	*Staphylococcus aureus*, *L. monocytogenes*, *E. coli* O157:H7	(59)
Meat industry wastes	*Clostridium perfringens*, *Salmonella* spp. *E. coli* O157:H7, *L. monocytogenes*	(58)

Table 6. Microbiological safety studies in valorised food wastes [(Adapted from Socas-Rodríguez et al. (6)]

Food waste	Extracted compounds	Aim	Safety analysis	Results	References
Fruit (Sweet cherry pits, date, and grape) seeds	Phenolic compounds	Exploring bioactive substances and ensuring food safety	Pesticides, mycotoxins, and heavy metals	Date seeds exhibited high potential for food and pharmaceutical applications	(36)
Coffee silverskin	Fiber, proteins	Use of coffee by-products in cereal-based food	Aerobic mesophilic bacteria, total coliforms, molds and yeasts, *Salmonella* spp., *Escherichia coli,* and *Staphylococcus aureus* counts	The sum of aflatoxins (B_1, B_2, G_1, G_2) are under the established limits for food safety	(37)
Banana peel flour	Fiber, proteins, amino acids, polyunsaturated fatty acids, antioxidants compounds, vitamin K	Preparation of gluten-free products	-	Physicochemical analyses were carried out in the final product	(38)
Snow crab cooking wastewater	Proteins, minerals, aromas, antioxidants	Valorisation potential for food applications	*Bacillus cereus, C. perfringens, E. coli, Salmonella* **spp.**, *S. aureus* counts	Their safety was verified	(39)
Potato peels	Antimicrobials and antioxidants	Extraction of potential antibacterial agents	-	Physicochemical analyses were carried out for final product. Potato peel extracts could be used as natural preservatives or antioxidants, as well as promising anti-sprouting agents	(52)
Potato peels		Lemon carbonated soft drink	Coliform and *E. coli* counts	Microbiological analyses were carried out for final product. Coliform and *E. coli* are not detected in lemon soft drink formulations	(53)

Table 5 presents the wide range of applications in this area, with the main objective being to extract valuable bioactive compounds. However, as the literature review shows, most studies did not include a microbial safety study. The most recent research were listed in Table 5.

This table shows the variation in research methodologies for assessing the microbiological safety of food waste. While most research focuses on the use of food waste to produce functional foods, few include comprehensive safety assessments. For example, Mateus et al. (36) aimed to investigate both the antioxidant properties and the safety of food waste (Sweet cherry pits, date, and grape seeds), with the aim of its safe application according to circular economy practices. To this end, they identified three major chemical contaminants, namely pesticide residues, mycotoxins and heavy metals. Moncalvo et al. (54) assessed the microbiological safety of waste grape skins and extracts for mycotoxin presence. On the other hand, Bouaziz et al. (55) used date seeds in their study to develop a functional chocolate spread enriched with dietary fiber from date seeds and to evaluate the effect of the dietary fiber addition on quality characteristics of the obtained product. However, they did not evaluate the safety of this waste. This lack of microbiological safety assessment is a significant gap, as the safety of these wastes is important for their effective use in food applications. Future research should focus on microbiological safety studies to ensure the reliability and consumer acceptance of food waste-derived products, supporting both sustainability and food safety objectives. However, the ability to differentiate between the controlled growth of specific microorganisms during the processing of food waste and the presence of potentially hazardous conditions that could adversely impact consumer health represents another challenge in the assessment of the microbiological safety of food waste. On the other hand, microbial safety analyses have been conducted on the final product in some studies. While microbial analyses of the final product are valuable, a more comprehensive approach that encompasses all stages of the production process is necessary to ensure microbial safety more effectively. This is a crucial requirement for the safe and sustainable recycling of food waste. However, a review of the literature revealed that there are currently no regulations regarding the microbial quality of food wastes before their utilisation. For example, Beltrán-Medina (37) evaluated the potential use of a coffee silverskin in a cereal-based extruded food product and, prior to its use, characterised and evaluated its safety by chemical composition studies, microbiological determinations, aflatoxin measurements and acute toxicity tests. They noted that, in the absence of specific microbiological regulations for coffee silverskin, the standards for roasted coffee and the official Mexican regulation for cereals and their products were used for comparison. This highlights the need for further research to establish specific regulations for waste products.

CONCLUSION

Food waste management is a major challenge on a global scale, prompting the development of innovative processes and methodologies. Food waste contains valuable compounds such as flavonoids, phenolic compounds, carotenoids, anthocyanins, pectin, proteins, dietary fibres, and enzymes. Functional food production using food waste has been an important research topic in recent years. However, there are challenges for using aformentioned compounds from food wastes, including biological instability and the risk of pathogen contamination. Many studies have revealed that these wastes can provide valuable contributions to the food industry by increasing their nutritional value and functional properties. However, research on the microbial safety of these wastes is very limited. It is critical to evaluate whether food wastes used in functional food production are safe, especially in terms of microorganism contamination. These wastes, when not processed properly, can create a suitable environment for pathogens and may adversely affect the health benefits of the final product. Despite increasing safety concerns in this area, only a limited number of safety assessment studies have been conducted. This problem will lead to the need for specific regulations for the valorisation and safety of food waste. Therefore, ensuring the microbial safety of functional foods produced using food wastes is a great need

for applied research in this field, and more in-depth investigations are required. Consequenlty, this study contributes to the existing literature by providing a comprehensive evaluation of the potential of food waste in functional food production, emphasizing both the benefits and the critical microbiological safety considerations, which are often overlooked in previous research.

Author Contribution

Study design: AKP, IS; Drafting the manuscript: AKP, IS; Critical review for content: AKP, IS; final approval of the manuscript; AKP, IS.

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Conflict of Interest

The authors declared that they have no conflict of interest.

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Review Article / Derleme Makale

Mutfaktaki Altın Baharat Zerdeçalın Farklı Disiplin Alanlarında Kullanımı

Use of Turmeric, the Golden Spice in Kitchen in Different Discipline Areas

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Özet

Mutfakta zerdeçal; baharat, renk verici ve lezzet arttırıcı gibi özellikleri ile kullanılmaktadır. Bu özellikleri sayesinde gıda endüstrisinde de çeşitli ürünlere katkı maddesi olarak ilave edilmektedir. Gıda sektöründe sadece katkı maddesi olarak değil aynı zamanda raf ömrünü arttırma ve doğal ambalajlama yöntemi olarak kullanıldığı yapılan çalışmalarla desteklenmiştir. Zerdeçalın içerisinde bulunan ve ana bileşeni olan kurkumin renk verme özelliği sayesinde, gıdalarda doğal renk oluşumunu sağlamaktadır. Bu haliyle peynirlerde, salamuralarda ve çeşitli soslarda renk verici madde olarak kullanılmaktadır. Bunların yanı sıra zerdeçal içerisinde bulunan kurkumin sayesinde antimikrobiyel ve anti-inflamatuvar etkiye sahiptir. Bu etkileri sayesinde sadece mutfakta baharat olarak değil diğer disiplin alanları ile de ilişkilendirilmiştir. Yüzyıllar öncesinde Çin ve Hint tıbbında geleneksel tedavi yöntemi olarak kullanılan zerdeçal günümüzde de tamamlayıcı tedavi yöntemi olarak sıklıkla tercih edilmektedir. Bunların yanı sıra antimikrobiyel özellikleri sayesinde medikal tekstil ürünlerinde, derma-kozmetik ürünlerde diş tedavilerinde kullanılmaktadır. Sağlık alanında yapılan çalışmalarla diyabet, kanser, Alzheimer ve Parkinson gibi ciddi hastalık durumlarında tamamlayıcı tedavi yöntemi olarak kullanıldığı ifade edilmektedir.

Abstract

Turmeric is used in the kitchen for its properties as a spice, colorant, and flavor enhancer. Due to these characteristics, it is also added as an ingredient to various products in the food industry. Studies have shown that turmeric is not only used as an additive in the food sector but also as a natural packaging method and to extend shelf life. The main component of turmeric, curcumin, contributes to natural color formation in foods due to its coloring properties. Because of this, it is used as a colorant in cheeses, brined products, and various sauces. In addition, thanks to the curcumin it contains, turmeric has antimicrobial and anti-inflammatory effects. These properties have led to its association with various disciplines beyond its use as a spice in the kitchen. Turmeric has been used in traditional Chinese and Indian medicine for centuries, and today, it is still frequently preferred as a complementary treatment method. Furthermore, due to its antimicrobial properties, it is utilized in medical textile products, dermo-cosmetic products, and dental treatments. Studies in the healthcare field indicate that turmeric is used as a complementary treatment method for serious diseases such as diabetes, cancer, Alzheimer's, and Parkinson's.

Extendend abstract

Aim and Introduction: The primary aim of this study is to review a research that demonstrates the use of turmeric, which has been utilized in kitchens for thousands of years, in other disciplines as well. Turmeric has played an active role in kitchens for a long time, serving as a spice, flavor enhancer, and in various dietary forms. Recent studies indicate that turmeric is not only significant in the kitchen but also in many other fields. These disciplines include the food industry, complementary medical treatments, the cosmetics sector, textiles, and more. In this context, turmeric is not just a spice but also plays various roles in different areas.

Turmeric is a tropical plant belonging to the ginger family, used as curry powder in South and Southeast Asian cuisines, and is regarded as the "golden spice." With a medicinal value for human health, turmeric contains 3–6% terpenes, 6–10% oil, and 3–6% fiber. The turmeric obtained from the *Curcuma longa* plant contains 3–6% curcumin. Curcumin is a yellow pigment with biologically active properties. Having relatively low toxicity, curcumin is generally considered safe (GRAS) and is approved by the FDA (United States Food and Drug Administration). For many years, curcumin had been used in Ayurvedic and traditional Chinese medicine (1). For centuries, people on the Indian subcontinent had used turmeric as a food component and for the treatment of various diseases without side effects. Research shows that turmeric had been used in India for at least 6,000 years for many purposes, such as medicine, cosmetic ingredients, spices, and dyes. Marco Polo mentioned turmeric in his writings about his journeys to China and India in 1280, and it was introduced to Europe by Arab traders in the 13th century. In the 15th century, Portuguese explorer Vasco da Gama introduced spices to the West after visiting India (2).

Methodology: This study is review based and made on a literature survey. The data of this research were obtained from Google Academic, Researchgate, DergiPark and PubMed databases. The aim of the study is to examine the effects of turmeric, known as a spice and commonly used in kitchens, on other disciplinary fields and to demonstrate the effectiveness of turmeric through recent studies in these areas.

Literature review: In addition to providing flavor to foods, turmeric is referred as the "queen of the kitchen" and is used in traditional medicine for treating various diseases, including gallbladder disorders, loss of appetite, cough, diabetes, various wounds, liver diseases, rheumatism, and sinusitis. Turmeric possesses a wide range of biological activities, including antioxidant, anti-inflammatory, anticarcinogenic, antidiabetic, antimicrobial, antifungal, antiparasitic, antiulcer, blood pressure-lowering, and cholesterol-lowering effects (3). Antioxidants are compounds that prevent or delay oxidative degradation, interacting with oxygen present in foods to inhibit adverse effects. Spices containing phenolic and flavonoid compounds exhibit antioxidant effects. Consuming these spices in certain amounts can meet the body's required level of antioxidant activity. Antioxidants delay or inhibit cell damage through their

radical-scavenging properties. They prevent premature aging and protect against cancer and many diseases by boosting the body's resistance. Antioxidants taken through diet can support mental development and protect against diseases such as Parkinson's and Alzheimer's (4). Generally used as a coloring agent in foods, turmeric contains tetrahydroc curcumin, an odorless, heat-resistant antioxidant compound. Curcuminoids constitute the main components of turmeric. Curcumin, that is the active component of turmeric, is an effective antioxidant that scavenges superoxide radicals such as hydrogen peroxide, and nitric oxide (5). Turmeric is frequently used in meat, fish, and grain dishes as a spice. In addition, turmeric is also used as a coloring and flavoring agent in mustard, margarine, butter, cheese, and pasta (6).

The usage of turmeric varies across different culinary cultures. In American cuisine, it is used in curries and soups. In British cuisine, it is found in rice and meat dishes. In Indian cuisine, it is used in fish, vegetable, and meat dishes, pickles, and sauces. In Indonesian cuisine, it is included in the dish "nasi kuning". In Japan, it is consumed as tea. In Malaysian cuisine, it is used as a spice in chicken dishes. In Sri Lankan cuisine, it is used in the marinade of lamb and fish dishes. In Thai cuisine, it appears in rice, fish, and chicken dishes. In Pakistani cuisine, it is used in sauces such as hamburger sauce. In Turkish cuisine, it is used in meat dishes, soups, sauces, rice, and various desserts and beverages (6).

The main active compound of turmeric, curcumin, has functional properties such as antidiabetic, anticancer, and antioxidant effects. Curcumin is frequently used in treatments for acne, wound healing, eye infections, skin diseases, and psychiatric conditions such as stress and depression. Furthermore, its healing effects on cancer, lung diseases, heart conditions, and nervous system disorders have been proven by many researchers (7).

Although as a natural dye curcumin is used in food coloring, it is also utilized as a fabric dye in textiles due to its antimicrobial properties. Natural dyes typically inhibit microorganism growth without toxicity (8).

Packaging is designed to protect food from moisture, temperature, and microorganisms. Additionally, packaging provides consumers with information about products, such as ingredients, nutritional value, production date, and shelf life. Traditional petroleum-based packaging materials are widely used in the packaging industry due to their low cost and ease of processing. However, these materials are non-biodegradable and non-reusable, leading to environmental pollution and resource scarcity, posing risks to human health. To prevent this situation, there is a need for green technology and biodegradable packaging. Curcumin, with its antimicrobial and antioxidant properties, can be used in the development of multifunctional films and coatings (5).

Conclusion: Throughout history, turmeric had been used as a spice in kitchens, but beyond this characteristic, it established its place in health, food, and many other fields. Due to the curcumin content, it includes strong antioxidant and anti-inflammatory properties. In this regard, it has been used as a complementary treatment method in health, as well as a natural dye in the food and textile industries. Beyond its coloring ability in the food sector, it is also used as packaging material due to its natural degredable structure. Additionally, curcumin extends the shelf life of foods and ensures food safety in the food industry.

The versatile nature of turmeric, which allows its use in different disciplines, highlights the many benefits that it naturally offers. Nowadays, there is an increasing trend toward natural methods almost in every area. Therefore, increasing the number of studies conducted will contribute to a better understanding and application of turmeric. In this way, the health benefits of turmeric, and its applications and benefits in the food industry can reach to broader consumers.

Giriş

Zerdeçal, sarı çiçekleri ve geniş yaprakları olan yumrulu, otsu ve çok yıllıklı *Curcuma longa L*. bitkisinden elde edilmektedir. Zencefil ailesinden olan bu bitki tropikal iklimde yetişmektedir (7). Zerdeçal, su (%80-90), karbonhidrat (%13), protein (%2), mineral (%2) ve lipid (%1) ve yaklaşık olarak %3-8 oranında kurkumin içermektedir. Kurkumin, antiseptik, anti-inflamatuvar ve antioksidan özelliklere sahip olup, Alzheimer, diyabet, astım ve mide ülserleri gibi hastalıklara karşı tamamlayıcı tedavi yöntemi olarak kullanılmaktadır (9). Buna göre Chuengsarman vd., prediyabetik etkilere sahip kişilerde kurkumin kullanımının Tip-2 diyabet oluşumunu geciktirmede etkisini belirlemek için bir çalışma yürütmüşlerdir. Çalışmaya göre, prediyabetik etki gösteren 240 kişiye 9 ay boyunca kurkumin veya plasebo kapsülleri rastgele dağıtılmıştır. 9 ay sonrasında çalışmada, plasebo grubundaki kişilerin %16,4'ü Tip-2 diyabet etkisi gösterirken kurkumin kapsülleri alan kişilerin hiçbirinde Tip-2 diyabet etkisi gözlenmediği belirtilmiştir (10).

Aynı zamanda zerdeçal, antibakteriyel ve antiseptik özellikleri sayesinde egzama ve akne oluşumuna karşı da etkilidir (2). Liu ve Huang, yürüttükleri çalışmada, akne oluşumu ile ilişkilendirilen *S. epidermidis* bakterisine karşı kurkumin kullanımının bu bakteriyi inhibe ettiğini ifade etmişlerdir (11). Bu haliyle de zerdeçal kozmetik endüstrisinde sıklıkla tercih edilmektedir (2).

Sağlığa olan etkilerinin yanı sıra zerdeçal, çeşitli kültürlere ait mutfaklarda da kendine yer bulmuştur (6). İspanyol mutfağının *Paella* yemeğine ve Hindistan mutfağına ait *curry* sosuna zerdeçal ilave edilmektedir. Asya ülkelerinde de zerdeçal, çay olarak sıklıkla tüketilmektedir. 16. yüzyılda ise Türk mutfağına giren zerdeçal, pilava renk vermek için safranın yerine kullanılmıştır. Zerdeçalın safran yerine kullanılması, düşük maliyetli bir alternatif olmuştur. Bunlara ilaveten zerdeçal; salatalarda, pilavlarda ve et yemeklerinde lezzeti arttırması, yemeğe sarı renk vermesi gibi amaçlarla kullanılırken, balık çorbası ve çeşitli sebze yemeklerinde de baharat olarak eklendiği bilinmektedir (12).

Kara ve Altındağ, disiplin kavramını, belirli bir araştırma konusuna sahip, birikmiş uzmanlık bilgisini etkin bir şekilde kullanan, teoriler ve kavramlar içeren, belirli terminolojilere ve araştırma unsurlarına entegre edilmiş teknik dile sahip bir kavram olarak ele almışlardır (13). Bu tanımdan yola çıkarak, çalışmamızda "farklı disiplinler" kavramını şu şekilde değerlendirdik:

- **Tıp disiplini**: Zerdeçalın sağlık üzerindeki etkilerine ilişkin yapılan çalışmalar,
- **Dermakozmetik disiplini**: Cilt bakım ürünlerindeki kullanımı,
- **Gıda mühendisliği disiplini**: Gıda endüstrisindeki uygulamaları,
- **Tekstil disiplini**: Kumaşlar üzerine yapılan araştırmalar,
- **Gastronomi disiplini**: Mutfakta zerdeçalın yalnızca baharat olarak değil, farklı ürünlerde kullanımı.

Bu derleme çalışmasındaki amaç, zerdeçalın sadece bir baharat olarak mutfakta kullanımını değil aynı zamanda farklı disiplin alanlarında kullanımını araştıran güncel çalışmaları incelemektir.

Zerdeçal ve tarihçesi

Zerdeçal, zencefil ailesine ait sarı çiçekli, büyük yapraklı ve yumrulu çok yıllık bir bitkidir. Polifenol içeren bu bitki keskin bir aromaya sahiptir. Doğal habitatı Güney Asya olan zerdeçal; zerdeçöp, zerdeçav, sarıboya, safran kökü ve Hint safranı gibi isimlerle de anılmaktadır. Özellikle Hindistan, Pakistan, Bangladeş, Çin ve Asya'nın tropik bölgelerinde yetişmektedir. Aktif maddesi kurkumin olan zerdeçal, *Curcuma longa* bitkisinin köklerinden elde edilen sarı renkli pigmenttir (14). Polifenolik bir bileşik olan kurkumin, antimikrobiyel ve antioksidan özelliklere sahiptir (15). Zerdeçal ve kimyasal yapısına ait görsel Şekil 1'de verilmiştir.

Başta Hindistan olmak üzere eski yazıtlar incelendiğinde zerdeçalın önemli bir bitki konumunda olduğu görülmektedir. Hint safranı olarak bilinen zerdeçalın kullanımı MÖ 4000 yılına kadar uzanmaktadır. Asırlık Hint tıp

sistemi olan Ayurveda'da adı geçen zerdeçal, Vedik çağ olarak bilinen dönemde (MÖ 1700-800) ve eskimeyen vedaları açıklayan Hint dili olan Sanskritçe'de adına ve kullanımına rastlanmaktadır. Sanskritçe'de *Haridara* olarak adlandırılan bu kelime esasında iki kelimeden meydana gelmektedir. *Hari* ve *Dara* her şeye gücü yeten ve her yerde bulunan Hindu tanrısı *Hari* olarak da bilinen *Vişnu* anlamına da gelmektedir. *Dara* kelimesi ise, kişinin giydiği şey anlamına gelmekte ve bu haliyle de *Vişnu'nun* zerdeçalı vücudunda kullandığı gerçeğini yansıtmaktadır. Hindistan'da zerdeçal; renklendirici, tatlandırıcı ve sindirimi kolaylaştırıcı gibi pek çok amaçla kullanılmıştır (17). Marco Polo, zerdeçaldan Hint safranı olarak bahsetmiş ve kumaş boyası olarak kullanmıştır. 1870'li yıllarda kimyagerler, zerdeçalın turuncu-sarı kök tozunun alkali kimyasallarla etkileşime girdiğinde kırmızımsı kahverengiye dönüştüğünü keşfetmişlerdir. Bu keşifle beraber alkali özelliğini test etmek için zerdeçal kâğıdı geliştirmişlerdir. Zerdeçal kâğıdı aynı zamanda alkaloitler ve borik asit için de test amaçlı kullanıldığı ifade edilmektedir (18).

Zerdeçalın besinsel ögeleri

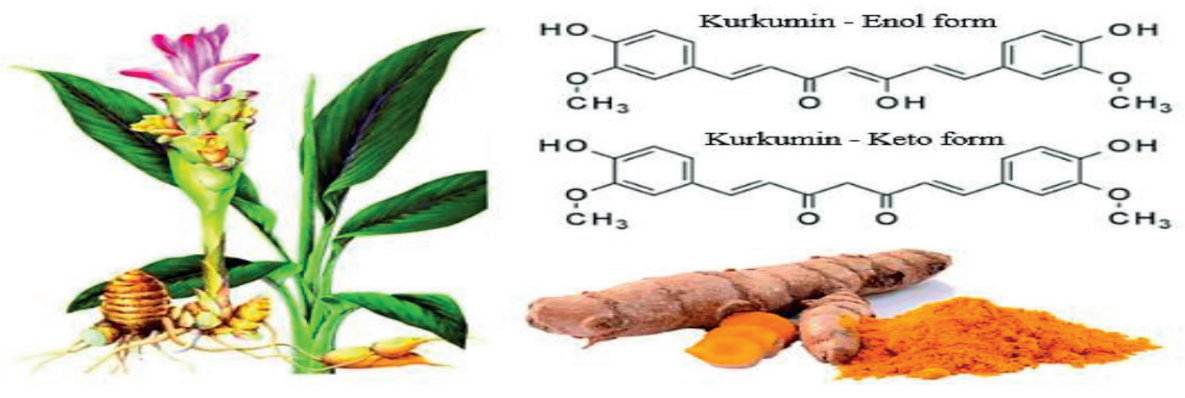
Zingiberaceace familyasından tropikal rizomlu bir bitki olan zerdeçal, Güney ve Güneydoğu Asya mutfağında köri tozu olarak kullanılan *altın baharat* olarak kabul edilmektedir (1). Zerdeçalın ana etken maddesi demetoksikurkumin olan kurkumindir (19). Kurkumin, zerdeçalda %3-6 oranında bulunan ve biyoaktif özelliklere sahip olan sarı pigmenttir (1). Sarı renkli fenolik pigment olan kurkumin aktif makrofajlardan süperoksit radikallerini, hidrojen peroksiti ile nitrik asidi temizleyerek güçlü bir antioksidan olarak işlev görmektedir. Kurkumin, antioksidan ve radikal temizleme özelliğini içerdiği polifenollerden almaktadır (19).

Zerdeçalın 100 g'ında; 390 kilokalori enerji, 10 g toplam yağ, 3 g doymuş yağ, 0 mg kolesterol, 0,2 g kalsiyum, 0,26 g fosfor, 10 mg sodyum, 2500 mg potasyum, 47,5 mg demir, 0,9 mg tiamin, 0,19 mg ribolflavin, 4,8 mg niasin, 50 mg askorbik asit, 69,9 g toplam karbonhidrat, 21 g diyet lifi, 3 g şeker ve 8 g protein bulunmaktadır. Bunların yanı sıra zerdeçal, A vitamini, E vitamini, ß-karoten, C vitamini, tiamin klorür, riboflavin, nikotinik asit, B_6 vitamini ve folik asit içermektedir (20). Zerdeçalın köklerinin kurutulup toz haline getirilmiş özü, %69,4 karbonhidrat, %6,3 protein, %5,1 yağ, %3,5 mineral ve %13,1 nem içermektedir. Bol miktarda karbonhidrat ve lif içermesine rağmen zerdeçal kolesterol bakımından oldukça fakirdir. Bunların yanı sıra zerdeçal içerdiği piridoksin, C vitamini, fosfor, kalsiyum ve magnezyum sayesinde doğal besleyici bir ürün olmaktadır (16). EFSA'ya (European Food Safety Authority-Avrupa Gıda Güvenliği Otoritesi) göre zerdeçalın günlük alım miktarı 3 mg/ kg vücut ağırlığı şeklinde olmalıdır (21).

Zerdeçalın sağlık üzerine etkileri

Zerdeçal, yüzyıllardır Hindistan ve Çin'de geleneksel şifa uygulamalarında yer almaktadır. Öyle ki zerdeçalın cilt hastalıkları, göz enfeksiyonları, solunum yolu rahatsızlıkları, diş

Şekil 1. Zerdeçal ve kimyasal yapısı



Kaynak: (16)

hastalıkları ve sindirim sistemi bozukluklarını tedavi etmede kullanıldığı bilinmektedir (22). Zerdeçalın sağlık üzerine etkileri, genellikle bitkinin köklerinden elde edilen kurkumin adlı turuncu-sarı renkli, lipofilik bir polifenol maddeden olduğu ifade edilmektedir. Kurkuminin; antioksidan, anti-inflamatuvar, anti kanser üzerinde etkileri olduğu ve bu etkileri sayesinde başta kanser olmak üzere otoimmün, nörolojik, kardiyovasküler hastalıklar ve diyabet gibi çeşitli hastalıkların önlenmesinde ve tedavisinde önemli rol üstlendiği yapılan çalışmalarla desteklenmektedir (7). Kurkuminin, romatoid artrit, inflamatuvar bağırsak hastalıkları, Alzheimer, kolon, mide, akciğer, meme ve cilt kanserleri gibi kronik hastalıkların tedavisinde etkili olduğu ifade edilmektedir (23).

Ek olarak zerdeçal, sindirim sistemi rahatsızlıklarında da sıkça tercih edilmektedir (24). Zerdeçalın içerisinde bulunan kurkumin, ishal, hazımsızlık, akıntı, gastrik ve duedonal ülserlerin birçok semptomlarını hafifletmekte aynı zamanda mukozal koruma yoluyla ilaçların neden olduğu yan etkileri azalttığı araştırmalar ile ortaya konmuştur (25).

Bu araştırmalara örnek olarak, Khonche vd. randomize plasebo kontrollü çalışmalarında; peptik ülser tanısı konan hastalar üzerinde klaritromisin (500 mg), *amoksisilin* (1000 mg) ve *pantoprazol* (40 mg) içeren standart *Helicobacter pilori (H. pilori)* tedavisine ek olarak kurkumin (500 mg/gün) ve plasebo alacak şekilde bir tedavi yöntemi uygulamışlardır. Çalışmada, dispepsi semptomlarının şiddeti *Hong Kong Dispepsi Indeksi (HKDI)* ile değerlendirilmiş ve *H. pilori* eradiksiyon tedavisi bittikten 4 hafta sonra sonuçlar üre nefes testi ile ölçülmüştür. Sonuçları inceleyen çalışmacılar, kurkumin ek tedavili olan hastalarda *HKDI* skoruna göre dispepsi semptomlarında plasebo alan hastalara göre daha büyük bir iyileşme olduğunu belirtmişlerdir. Yapılan tedavi sürecinde kurkumin güvenli olarak değerlendirilmiştir. Çalışma sonucunda, peptik ülser tanısı konan hastalarda standart *anti-helicobakter* tedavisi üzerine kurkumin eklenmesinin dispepsi semptomlarını iyileştirdiğini ancak *Helicobacter pilori* enfeksiyonunun eradiksiyonu üzerinde arttırıcı bir etkisi olmadığını da ifade etmişlerdir (26).

Bir başka çalışmada, Mohammadi vd., obez bireylerde kurkuminin hipolipidemik etkilerini incelemişlerdir. Randomize ve plasebo kontrollü olan bu çalışmada, katılımcılara 30 gün boyunca günde 1 g kurkumin veya plasebo verilmiştir. Süre bitiminde sonuçları değerlendiren çalışmacılar, kurkumin takviyesinin, serum trigliseritlerini anlamlı derecede azalttığını ancak toplam kolesterol, düşük yoğunluklu lipoprotein kolesterol, yüksek yoğunluklu lipoprotein kolesterol ve yüksek duyarlılıklı C-reaktif protein seviyeleri ile antropometrik parametreler üzerinde etkili olmadığını ifade etmişlerdir. Ayrıca kurkuminin trigliserit seviyesi düşürmede etkili olduğunu fakat lipid profili parametreleri, vücut kitle endeksi üzerinde önemli bir etkisi olmadığını belirtmişlerdir (27).

Zerdeçalın yapısı ve hasat edilmesi

Zerdeçal her yıl, temmuz ayından mart ayına kadar hasat edilir ve yaprakları kuruyarak sarıya dönüşür (28). Zerdeçal bitkisinin toprak altında bulunan ana kökleri yumurta veya armut biçimindeyken yan kökleri parmak biçimindedir (29). Hasat edilen rizomlar (kökler) yabancı maddelerden temizlenir, yapraklar bitkiden ayrılır ve kökler yıkanır. Yaprak pulları ve uzun kökleri kesilir. Rizomların parmakları, bitkinin soğan kısmından çıkarılır, soğan ve parmaklar ayrı ayrı yığınlar halinde toplanır, yapraklarla örtülür ve bir gün süresince terlemeye bırakılır. Yeşil rizomları yumuşatmak ve rengini gidermek için 45-60 dakika aralığında kaynatılır. Köpük ve beyaz duman oluşumu gözlenirse kaynatma işlemi durdurulur (28). Zerdeçalın kalınlığını, nem içeriğini ve rengini korumak için kurutma işlemi yapılır (30). %5-10 nihai nem içeriğine ulaşması için kurutulan rizom parçaları, renk kaybını önlemek için güneş ışığından uzak tutulur. Rizomlar dilimlenerek kurutma süresi kısaltılır ve parlatma tamburlarında pürüzlü yüzeyler giderilir. Serin ve kuru bir ortamda depolanır. Zerdeçal bitkisi; zerdeçal tozu, köri tozu ve macunların ana bileşenidir ve çoğunlukla hardalı renklendirmek ve tatlandırmak için kullanılmaktadır (28).

Zerdeçalın farklı disiplin alanlarında kullanımı

Kurkumin, zencefil ailesinin bir üyesi olan zerdeçaldan üretilmektedir. Genel olarak güvenli kabul edilen (GRAS) statüsüne sahip olan kurkumin; gıda, tıp ve kozmetik gibi farklı disiplin alanlarının çeşitli uygulamalarında kullanılmaktadır. Kurkumin, belirgin sarı rengi sayesinde gıda endüstrisinde; unlu mamuller, süt ürünleri, hardal, bazı içecekler, dondurma ve salata sosları için kullanılmakta ve sentetik sarı boyaların yerine doğal boya olarak alternatif sunmaktadır. Aynı zamanda gıda endüstrisinde kurkumin, pH'ya bağlı renk değişimi nedeniyle meydana gelen gıda bozulmalarını takip etmek için pH biyosensörü olarak da kullanılmaktadır (31). Akıllı ambalaj sistemi, paketlenmiş gıdaların tedarik süreci, depolanması ve ürünün genel durumu hakkında bilgi vermesi gibi özellikleriyle de bu endüstride önemli bir yere sahiptir. Bitkilerden ve kök bitkilerden elde edilen *kurkumin*, *betanin*, *antosiyanin* ve *klorofil* gibi doğal gıda renklendiricilerin pH'ya karşı renk hassasiyeti göstermesi onların akıllı ambalaj sistemlerinde kullanılmasını sağlamaktadır (32). Bunların yanı sıra, doğal bir renklendirici olan kurkumin, alkali koşullarda deprotonasyona uğrar ve ambalaj filmi tarafından emilen ışığın dalga boyunu değiştirerek film rengini kızıl renge dönüştürür. Asidik koşullarda ise, protonasyon meydana gelir ve film sarı renge dönüşür. Bu sayede kurkumin, yüksek oranda yağ ve protein içeren gıdaların tazeliklerini inceleme amacıyla kullanılmaktadır (33). Ek olarak gıda kalite özelliklerini tespit etmede etkili olan kurkumin, akıllı ambalajlama sistemlerinde gıda etiketleme malzemesi olarak kullanılmaktadır (5).

Gıda endüstrisinde sıklıkla kullanılan nişasta ve selüloz zerdeçaldan elde edilmektedir. Nişasta, gıdalarda tatlandırıcı ve emülsifiye edici bir ajan olarak kullanılan bir polisakkarit iken; selüloz gastrointestinal sisteme yararlı etkileri olan reolojik (akış) değişken özelliği gösteren bir maddedir (34).

Gıda endüstrisinin yanı sıra zerdeçal tekstil alanında da önemli yer tutmaktadır. Toprak altı gövdelerinden elde edilen bir polifenolik bileşik olan kurkumin, sarı bir pigment olup anti-inflamatuvar, antioksidan ve anti-kanser gibi birçok faydalı özellik içermektedir (8). Dolayısıyla, kurkumin, medikal tekstilde kullanılan doğal bir malzemedir. Özellikle medikal tekstil, tekstil endüstrisinin en hızlı büyüyen alanlarından biridir. Kurkumin, geleneksel olarak kumaşları boyamak ve renklendirmek için kullanılmaktadır (35). İpek, yün ve ince derileri boyamak için zerdeçalın ana maddesi olan kurkuminden yararlanılmaktadır (36). Kurkumin bakterisidal etkisi sayesinde, tekstil ürünlerinde antimikrobiyel bir kaplama etkisi göstermektedir (37).

Geniş bir biyolojik aktiviteye sahip olan ve toksik bir yapı içermeyen kurkumin, diş hekimliği alanında da uygulanan endodontik tedavilerde, çeşitli lezyon ve mukoz tedavilerinde, gargaralarda, jellerde ve macunlarda boyama ajanı olarak kullanılmaktadır (3).

Bir başka kullanım alanıyla zerdeçal, geleneksel olarak cilt bakım ürünlerinde güzelleştirici ve yaşlanma karşıtı bir madde olarak uygulanmaktadır. Zerdeçalın içerisinde bulunan kurkumin, antioksidan ve anti-inflamatuvar özellikleri sayesinde cilt hücrelerini güneşin UV ışınlarından korumaktadır (38). Bu özellikleriyle kozmetik sektöründeki uygulamalarda yer almaktadır. Kırışıklık karşıtı, güneş koruyucu ve cilt yenileyici gibi özelliklere sahip olmasının yanı sıra kurkumin, tırnak bakımı, dudak bakımı gibi ürünlerde de renklendirici olarak kullanılmaktadır (39).

Zerdeçalın gıda katkısı olarak kullanımı

Zerdeçal, genel olarak gıdalarda renklendirici olarak kullanılmaktadır (40). Toz haline getirilmiş zerdeçal ise yemeklere baharat olarak eklenmektedir (41). Zerdeçal, turşu ve hardalda solmayı telafi etmek için kullanılmaktadır. Bunların yanı sıra zerdeçal içeriğindeki kurkumin sayesinde (turuncu-sarı renk) peynirleri, salamuraları, margarinleri, yoğurtları, kekleri, bisküvileri, patlamış mısırları, turşular, dondurmaları, sosisleri, kahvaltılık gevrekleri ve sosları renklendirmek amacıyla kullanılmaktadır (18,42).

Bir başka kullanım yeri ise, zerdeçalın içeriğinde bulunan *oleoresin* bileşeninin yağ içeren ürünlerinde, köri tozlarının üretiminde ve güneş ışığından korumak için bazı paketlenmiş ürünlerdedir (18).

Zerdeçal, deniz ürünlerinin besin değerlerini korumada, antioksidan ve antimikrobiyel etkisiyle raf ömrü uzatmada, deniz ürünlerine tat ve renk katarak çekiciliğini arttırmada önemli rol oynamaktadır (12). Bu konuda bir çalışma yürüten Lim vd., buğday ekmeği yapımında buğday unu yerine çeşitli konsantrasyonlarda olan zerdeçal tozu ilave etmişlerdir. Zerdeçal tozu ilaveli ekmeklerin antioksidan özelliklerini analiz etmişlerdir. Zerdeçal tozu içeren ekmeklere *ß-karoten-linoleat* ağartma testi uygulanmış ve antioksidan aktivitesi değeri ölçülmüştür. Sonuçları değerlendiren çalışmacılar, zerdeçal tozu ilaveli ekmeklerin buğday unlu ekmeklere kıyasla antioksidan değerlerini daha yüksek olarak belirlemişlerdir. Bunun yanı sıra, yapılan ölçümlerde zerdeçal tozu ilaveli ekmeklerde bulunan zerdeçal tozu miktarı arttıkça antioksidan değerlerinde artış olduğu ifade etmişlerdir (43). Benzer bir çalışmada Hefnawy vd. tarafından yapılmış olup, bisküvilere zerdeçal tozu eklenmesinin antioksidan özelliklerini koruduğunu ve doğal antioksidan olarak kullanılabileceğini belirtmişlerdir (44). Zerdeçal ve çeşitli disiplin alanlarında kullanımı Tablo 1'de gösterilmiştir.

Zerdeçalın mutfakta kullanımı

Zerdeçal, tütsülenmiş yiyeceklerde, turşularda ve bazı keklerin yapımında kullanılmaktadır. Bunların yanı sıra, deniz ürünlerinde, balık çorbasında, yumurta yemeklerinde, çorbalarda, pilavlarda, tavuk etleri için soslarda, bazı tatlılarda, köri karışımında ve hardala zerdeçal eklenmektedir. Baharat ve zerdeçal çayı olarak da tüketilmektedir (4,12). Dünya mutfaklarına bakıldığında; Endonezya mutfağına has olan *Gulai*, *Sangsang*, *Jackfruit* meyvesine renk vermek için zerdeçal kullanıldığı, Malezya mutfağına özgü *Ikan Bakar*, *Ayam Goreng Kunyit* gibi ürünlerin zerdeçal ile zenginleştirildiği, İngiltere'de körilerde, pirinç ve et ürünlerinde renk verici olarak zerdeçal kullanıldığı belirtilmektedir. Hindistan mutfağında ise birçok üründe zerdeçal yer almaktadır (6). İspanya'da deniz ürünleriyle

Tablo 1. Zerdeçal ve çeşitli disiplin alanlarında kullanımı

Disiplin alanları	Kullanım	Amaç	Kaynak
Tıp-Sağlık	Tedavi uygulamaları	H. pilori tedavisi	Khonce vd. 2016 (26)
Tıp-Sağlık	Tedavi uygulamaları	Obez bireylerde trigliserid düşürme	Mohammadi vd. 2013 (27)
Diş Hekimliği	Endodontik tedavi	Gargara, macun ve jellerde boyama ajanı	Güçyetmez ve Topal, 2021 (3)
Derma-kozmetik	Tırnak ve dudak bakım ürünleri	Renk verme	Rafiee vd. 2019 (39)
Derma-kozmetik	Cilt bakım ürünleri	Yaşlanma karşıtı, güzelleştirici etki	Singh vd. 2024 (38)
Gıda bilimi	Gıda etiket malzemesi	Akıllı ambalaj sistemi	Roy vd. 2022 (5)
Gıda bilimi	Gıda katkısı	Doğal antioksidan etki	Hefnawy ve ark. 2016 (44)
Gastronomi-mutfak	Baharat	Safran yerine kullanım	Ayyıldız ve Sarper, 2019 (4)
Gastronomi-mutfak	Çeşitli yemeklere ilave	Renklendirici	Dalkılıç, 2019 (6)
Gastronomi-mutfak	Çeşitli içeceklere ilave	Yeni bir lezzet deneyimi	Dalkılıç, 2019; Ipar vd. 2022 (6);(47)
Tekstil	Kumaşlar	Renk verme	Akar ve Bulut, 2013 (36)
Tekstil-medikal uyg.	Tekstil ürünleri	Antimikrobiyel kaplama etkisi	Han ve Yang, 2005 (37)

hazırlanan meşhur *Paella* yemeğine de zerdeçal eklendiği bilinmektedir (45).

Osmanlı Mutfağında ise, bir kebap türü olan *Salma aşı* yemeğine baharat olarak zerdeçal eklendiği bilinmektedir. Aynı zamanda Osmanlı Mutfağında pişirilen nohutlu pilavın içerisine de safran yerine zerdeçalın ilave edildiği ifade edilmektedir. Birçok baharatı bünyesinde barındıran *Mesir macunu* da zerdeçal içermektedir (4). Zerde tatlısında da zerdeçal ilave edilmekte ayrıca pirinç ve bal da kullanılmaktadır. Coğrafi işaret alan sütlü zerde tatlısına da zerdeçal ilave edilmektedir (46).

Yemeklerin yanı sıra içeceklerde de zerdeçal kullanılmakta, zerdeçal çayı, zerdeçal smoothie, zerdeçal zencefil limon çayı gibi içecekler bunlara örnek verilebilmekte ve tercihe göre sıcak veya soğuk olarak tüketilmektedir (6). Zerdeçal sütü (Altın süt) ise, süte zerdeçal ilave edilmesi ve sütün kaynatılması şeklinde hazırlanmaktadır (47).

SONUÇ

Zerdeçal, içerdiği kurkumin sayesinde bir baharat olmanın ötesine geçmiş birçok disiplin alanı için değerli bir bileşen haline gelmiştir. Gıda, sağlık, tekstil ve kozmetik gibi çeşitli disiplin alanlarında kullanım alanı bulmuştur. Antioksidan, antimikrobiyel ve anti-inflamatuvar etkileri ile ön plana çıkan zerdeçal, özellikle sağlık alanında tamamlayıcı tedavi yöntemi olarak önemli bir yere sahip olmuştur. Bunlara ilaveten kurkuminin çeşitli hastalıklara karşı koruyucu ve tedavi edici etkiler sunduğu yapılan bilimsel çalışmalarla desteklenmiştir. Özellikle diyabet, sindirim sistemi rahatsızlıkları, Alzheimer gibi ciddi hastalıkların tedavisinde tamamlayıcı bir yöntem olarak kullanılabilirliği oldukça dikkat çekicidir. Bunların yanı sıra, ayurvedik beslenme sisteminde zerdeçal, beden ve zihin sağlığı için tarih boyunca kullanıldığı yapılan çalışmalar ile desteklenmiştir. Cilt sağlığını destekleyen özellikleri sayesinde de derma-kozmetik ürünlerin geliştirilmesinde önemli bir rol oynadığı yapılan araştırmalarla ifade edilmiştir. Sağlığa olan faydaları, yapılan bilimsel çalışmalarla desteklenen zerdeçal, bilinçli ve kontrollü bir şekilde tüketilmeli, Avrupa Gıda Güvenliği Otoritesi (EFSA) tarafından belirlenen günlük tüketim miktarlarına dikkat edilmesi önerilmektedir.

Gıda endüstrisinde ise zerdeçal, yalnızca lezzet ve renk katma amacıyla değil gıda ürünlerinin etiketlenmesinde, pH değerlerini izlemede ve akıllı ambalaj sistemlerinde kullanılma gibi görevler de üstlenmiştir. Bunların yanı sıra zerdeçal antioksidan özellikleri sayesinde gıda ürünlerinde katkı maddesi olarak kullanılmış böylelikle gıdalarda doğal katkı maddesi olarak yer almıştır.

Zerdeçalın yararları sadece sağlık ve gıda alanlarında sınırlı kalmamıştır. Tekstil endüstrisinde de kurkuminin doğal renk verici özelliği sayesinde ipek ve yün gibi kumaşlarda renk verme amacıyla kullanıldığı belirtilmiştir.

Çok yönlü özellikleri sayesinde zerdeçal, geçmişten günümüze değerini korumuş hem eski zamanlarda hem de modern dünyada kendine yer edinmiştir. Doğal özellikleri ve fonksiyonel yapısıyla zerdeçal, gelecekte de daha fazla araştırmaya konu olmalı, farklı disiplinlerdeki yenilikçi uygulamalarda da yer almalıdır.

Araştırmacıların katkı oranı beyanı

Bu derleme çalışmasına her iki yazar da eşit oranda katkı sağlamıştır.

Çıkar çatışması beyanı

Bu derleme çalışmasında herhangi bir çıkar çatışması söz konusu değildir.

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