GIDA (2011) 36 (5): 249-253 *Research* / Araştırma

SENSORY EVALUATION OF FLAVORED EXTRA VIRGIN OLIVE OIL

H. Hande Akçar, Aytaç S. Gümüşkesen*

Ege University, Engineering Faculty, Food Engineering Department, Izmir, TURKIYE

Received / Geliş tarihi: 02. 06. 2011
Received in revised form / Düzeltilerek geliş tarihi: 08. 08. 2011
Accepted / Kabul tarihi: 09. 08. 2011

Abstract
Flavored olive oil is produced by adding the flavors of various spices, herbs, fruits and vegetables or natural aromas to extra virgin olive oil. In this study; various natural aromas and aromatic herb extracts were added to extra virgin olive oil in a wide range of concentrations. Sensory evaluation is performed to determine the "most liked" concentration of natural aromas (*oregano, basilico, rosemary and bitter-orange*) and aromatic herb extracts (*oregano, basilico and hot pepper*) used to prepare flavored olive oil. Sensory evaluation of olive oil samples prepared in accordance with the trial plan was carried out with ranking test and paired-comparison test. Panelists preferred the olive oils flavored with 0.05% of natural oregano aroma and 0.07% of basilico, rosemary and bitter-orange aromas, the olive oils flavored with 20% of oregano extract and 40% of basilico and hot pepper extract. In addition, commercial flavored olive oils (*oregano, basilico, rosemary, bitter-orange and garlic*) were also subjected to sensory evaluation. In particular, at the end of the panel, the sample liking was the following: oregano> basilico> rosemary> hot pepper> garlic. According to the paired comparison-test, oregano flavored olive oil (0.05%) and flavored olive oil with oregano extract (20%) were statistically different at $P < 0.001$ from each other and the most like flavored olive oil was to prepare with natural oregano aroma.

Keywords: Olive oil, flavored olive oil, sensory evaluation, ranking test, paired-comparison test

ÇEŞNİLİ ZEYTİNYAĞLARININ DUYUSAL DEĞERLENDİRİLMESİ

Özet
Çeşnili zeytinyağı; natürel sızma zeytinyağlarına değişik baharat, meyve ve sebzeler veya bunların doğal aroma maddeleri katılarak çeşnilendirilmesi ile elde edilmektedir. Bu çalışmada çeşitli doğal aromalar (*kekik, fesleğen, biberiye ve turunç*) ve aromatik bitki ekstraktlarının (*kekik, fesleğen, acı biber*) değişik konsantrasyonlarda kullanılmasıyla hazırlanan çeşnili zeytinyağı örnekleri duyusal olarak değerlendirilmiştir. Deneme planına göre hazırlanan zeytinyağı örneklerinin duyusal değerlendirilmesi "sıralama testi" ve "eşlenmiş kıyaslama testi" ile gerçekleştirilmiştir. En çok beğenilen çeşnili zeytinyağlarının kekik için %0.05, fesleğen, biberiye ve turunç için %0.07 oranında doğal aroma kullanılarak hazırlanan çeşnili zeytinyağları olduğu saptanmıştır. Aromatik bitki ekstraktları kullanılarak hazırlanan çeşnili zeytinyağlarında ise kekik için %20, fesleğen ve acı biber için %40 oranında ekstrakt kullanılarak hazırlanan çeşnili zeytinyağlarının panelistler tarafından beğenildiği bulgulanmıştır. Ayrıca piyasadan temin edilen *kekik, fesleğen, biberiye, turunç ve sarımsak* aromalı çeşnili zeytinyağları da en çok beğenilen aromanın belirlenebilmesi amacıyla duyusal olarak değerlendirilmiştir. Sıralama testi sonucunda beğeni

* *Corresponding author* / Yazışmalardan sorumlu yazar ;
aytac.saygin.gumuskesen@ege.edu.tr (+90) 232 311 3019 (+90) 232 342 7592

sıralaması; kekik> fesleğen> biberiye> turunç> sarımsak doğal aromalı çeşnili zeytinyağlarıdır. Eşlenmiş kıyaslama testi sonuçları istatistiksel değerlendirilmesine göre; kekik aromalı zeytinyağı (%0.05) ve kekik ekstraktı ile çeşnilendirilmiş zeytinyağı (%20) arasında %99.5 olasılıkla farklılık olduğu saptanmıştır ($P < 0.001$). Ayrıca doğal kekik aroması ile hazırlanmış çeşnili zeytinyağı, kekik ekstraktı ile hazırlanmış zeytinyağına göre daha çok beğenilmiştir.

Anahtar kelimeler: Zeytinyağı, çeşnili zeytinyağı, duyusal değerlendirme, sıralama testi, eşlenmiş kayaslama testi

INTRODUCTION

Virgin olive oil is the only edible oil of great production obtained by physical methods from the fruit *Olea europaea* L., it shows sensory characteristics and nutritional properties which are the main reasons for the increment of its consumption all over the world in the recent years (1).

Spices such as garlic, hot peppers, oregano, rosemary and various herbs, generally used as flavor enhancers in the preparation of typical dishes, contain substances showing antimicrobial, antioxidant and anti-inflammatory activities. The addition of some of these spices and herbs to extra virgin olive oil is an ancient tradition, and the flavored oils are used to dress different types of dishes. The presence of spices and herbs, besides affecting the oil sensorial characteristics, has an impact on the shelf life and nutritional value of the flavored oil, as reported in the few studies carried out on oils of different origin (2).

Flavored olive oils gain increasing attention in recent years. They are usually prepared by macerating the aromatic herbs in the oil. Using this methodology flavor compounds are also co-extracted with undesirable ones, such as waxes and bitters, modifying the sensory characteristics and stability during shelf life. On the other hand, seasonality of the aromatic herbs does not allow their use in the flavored oils manufacture throughout the year. However, natural aromas obtained from these aromatic herbs are also used in the preparation of flavored olive oil (3).

Damechki et al. (4) examined the presence of antioxidants and pro-oxidants in oregano and rosemary flavored oils. Dry, ground herb material (oregano and rosemary) (5% w/w) was infused to olive oil for 24, 48 and 72 hours and then it was removed by filtration. Flavored oils produced at three different infusion periods (24, 48 and 72 hours) it was found that the addition of the herb material (treatment) had a highly significant effect on the flavor and taste of olive oil. Infusion time was not found to affect significantly the sensorial characteristics of both oregano and rosemary flavored olive oils.

A study is reported on the chemical and sensorial characteristics of extra virgin olive oil flavored with hot pepper, garlic, oregano and rosemary during 7 months of storage. In particular, at the end of the storage, the sample liking was the following: rosemary > hot pepper > oregano > garlic. As regards the flavoring concentrations, the highest levels were preferred for oregano and hot pepper (40 g/L > 20 g/L > 10 g/L). Concerning rosemary and garlic, the most appreciated concentrations were 20 and 30 g/L, respectively (2).

The relatively low presence of pure olive oil or extra virgin olive oil in nontraditional markets is primarily the result of a lack of knowledge about the product, directly derived from the weak international product marketing. Only 2% of total fat consumed in the world today correspond to olive oil (5). Within vegetable oils, olive oil accounts for about 3% of the world consumption (6) whereas the countries of the Mediterranean area, which account for 95% of the world production, still concentrate 85% of world consumption (7). Flavored and infused oils account for only a few per cent of the olive oil market, but even this small number of sales can be extremely profitable for retailers. Furthermore, market studies have demonstrated that consumers are interested in this kind of product (3), in particular, consumers originating from North Europe, America and Japan. These gourmet products are determining an increase of both the use of olive oil among nontraditional consumers

and the added value of olive oil (8). In Great Britain, although starting from a small base (£14 million in 2004) specialty oils, such as sprays, mild or light oils, non-olive/seed based and flavored oils, having increased their market value by as much as 76% between 2000 and 2004 even if that the mild and light varieties are providing a major boost. According to the information made public by an important company of the field, in the UK, basilico oil remains the most popular flavored oil, making up around 60% of its total sales. Chili oil comes next, totaling 15% of sales, garlic oil stands at 10% and lemon oil at 5%. Other infusions, such as coriander, rosemary, oregano and jalapeno remain relatively new products (9).

In this study, the type and concentration of the natural aroma (*oregano, basilico, rosemary, bitter-orange*) and aromatic herb extracts (*oregano, basilico, hot pepper*) more appreciated by the Turkish consumers were determined by ranking and paired-comparison tests. In addition, commercial flavored olive oils (*oregano, basilico, rosemary, bitter-orange and garlic*) were also subjected to sensory evaluation.

MATERIALS AND METHODS

Materials

Aromatic herb extracts such as *oregano, basilico and hot pepper* were purchased from Komili/ Yudum Factory, Ayvalık –Türkiye. Natural aromatic substances (*oregano, basilico, rosemary, bitter-orange*) and extra virgin olive oil were provided from Tariş Olive Oil Factory, İzmir-Türkiye.

Flavored olive oil samples were prepared by adding aromatic herb extracts (10, 20, 30, 40, 50, 60 %v/v for oregano, basilico, hot pepper) and natural aromas (0.03, 0.05, 0.07, 0.09, 0.11, 0.13 %v/v for oregano, basilico, rosemary, bitter-orange) to extra virgin olive oil at different concentrations. The flavored olive oil samples were then transferred in a 250 mL dark glass bottles and stored in the dark at +4°C.

Commercial flavored olive oils prepared by adding natural aromas such as *oregano, basilico, rosemary, bitter-orange and garlic* were also supplied from Tariş Olive Oil Factory, İzmir-Türkiye.

Methods

Sensory Evaluation of Flavored Olive Oils

Sensory evaluation of olive oil samples prepared in accordance with the trial plan, was carried out with ranking test and paired-comparison test (10-12).

Ranking Test was used to evaluate flavored olive oil samples. Sensory evaluation (mouth feel and appearance) was performed with 16 trained panelists. They ranked the samples in order of preference and indicated the extent of their preference for each sample in a 1-6 acceptability scale ranging from like extremely (1) to dislike extremely (6). The panelists were asked to smell, taste and rank them in order of their degree of odor and flavor acceptability and to describe the overall odor, flavor, and taste and after-taste perception of the samples.

Moreover, sensory evaluation was performed to determine the "most liked" aroma type from commercial flavored olive oil samples (*oregano, basilico, rosemary, bitter-orange and garlic flavored olive oils*).

The results of the panel were calculated statistically in corresponding to 6 treatments and 16 replications as specified the table "rank totals required for significance at the 5% level" by Kramer and Twigg (13).

Paired-comparison test for simple difference where two coded samples were presented to the panelists for evaluation on simple difference. The two samples may also be presented simultaneously, and the panelists in this case are required to state whether two samples are the same or different (13, 14). It was applied to flavored olive oil prepared by adding 0.05% natural oregano aroma and 20% oregano extract. These concentrations were a result of sensory evaluation by panelists identified as the most appreciated concentration values. Whether there is a difference in flavor between natural oregano aroma and oregano extract was determined. These two olive oils tested which have been preferable to sensory assessment of the flavored oil samples was carried out by a panel consisting of 8 trained members.

Statistical interpretation was carried out according to Kramer and Twigg's (13) table "rank totals

required for significance at the 5% level" which gives the maximum opportunities for demonstrating recognition by the assessors of differences between the samples, was applied to the rank preference test results for ranking analysis.

The panel scores and paired-comparison test results were evaluated from the table of Turkish Standards, Sensory Analysis-Parallel Comparison Test (TS-49202) (15).

RESULTS AND DISCUSSION

In this study, the panelists were asked to indicate percentage of natural aroma and aromatic-herb extracts concentration in extra virgin olive oil which comforts the extreme likeness. The panelists were asked to rank six coded samples in order of preference. Since these data are in ranked terms, we may analyze for statistical significance merely by summing the ranks for each treatment and comparing these ranked sums to the entries in Kramer and Twigg's Table (13) "rank totals required for P<0.05" for 6 treatments and 16 replications.

The two lower entries were 45-67 for 6 treatments and 16 replications in Kramer and Twigg's Table (P<0.05) (13). Rank sum for flavored olive oil with oregano, basilico and bitter-orange samples was calculated as 43 which was less than 45. Rank sum was calculated as 41 for flavored olive oil with rosemary which was less than 45. The results show that the panelists preferred the extreme likeness of oregano flavored olive oil at 0.05%; and basilico, rosemary and bitter-orange at 0.07% concentration level (Table 1).

According to the results, two upper entries were 40-72 and lower entries were 45-67 in Kramer and Twigg's Table (P<0.05) (13). The rank sum of oregano flavored olive oil and basilico flavored olive oil were less than 40 which were 38 and 28, respectively. The rank sum of hot pepper flavored olive oil was 41 which were below 45. The panelists preferred the extreme likeness of oregano flavored olive oil at 20%; basilico and hot pepper at 40% concentration level (Table 2).

Ranking test was performed to determine the "most liked" natural aroma for commercial flavored olive oil samples (*oregano, basilico, rosemary, bitter-orange and garlic*). Rank sum were calculated as 40, 41 and 42 for oregano, basilico and rosemary flavored olive which were below 45.

The sample liking was the following; oregano > basilico > rosemary > bitter-orange > garlic (P<0.05, Table 3). According to panel scores, commercial oregano flavored olive oil was the most preferred and garlic flavored olive oil was less popular than the others.

Damechki et al., Antoun N. and Tsimidoub M., (4, 8) performed a consumer preference test to oregano and rosemary flavored olive oils, according to the test results, oregano flavored olive oil was the most preferred.

Table 1. Rank sum of flavored olive oils with natural oregano, basilico, rosemary and bitter-orange aromas

Flavored olive oils type		The percentage of natural aroma concentration (%)					
		0.03	0.05	0.07	0.09	0.11	0.13
Rank Sum	*oregano*	55	43	50	58	60	70
	basilico	60	50	43	56	53	74
	rosemary	58	43	41	43	73	78
	bitter-orange	75	69	43	55	49	45

Table 2. Rank sum of flavored olive oils with oregano, basilico and hot pepper extracts

Flavored olive oils type		The percentage of aromatic herb extracts concentration (%)					
		10	20	30	40	50	60
Rank Sum	*oregano*	45	38	48	60	68	77
	basilico	74	52	50	28	59	73
	hot pepper	70	64	55	41	52	54

Table 3. Rank sum of commercial flavored olive oils with natural oregano, basilico, rosemary, bitter-orange and garlic aromas

Commercial flavored olive oils type	oregano	basilico	rosemary	bitter- orange	garlic
Rank Sum	40	41	42	53	64

Paired-comparison test was applied to the most preferred flavored olive oil with natural oregano aroma (0.05%) and flavored olive oil prepared with oregano extract (20%). The results show that olive oil flavored with natural oregano aroma (0.05%) and flavored olive oil with oregano extract (20%) were statistically different ($P<0.001$) and. Olive oil flavored with oregano aroma was most liked than olive oil flavored with oregano extract.

CONCLUSIONS

As a result of sensory evaluation, the optimum natural aroma concentrations were determined as 0.05% for oregano and 0.07% for basilico, rosemary and bitter-orange. The most like aromatic herb extract concentrations were 20% for oregano extract and 40% for basilico and hot pepper.

The ranking test was applied to commercial flavored olive oils to determine the most popular aroma type. So the sample liking was the following: oregano > basilico > rosemary > bitter -orange > garlic.

According to the *paired-comparison test,* oregano flavored olive oil (0.05%) and flavored olive oil with oregano extract (20%) were statistically different at $P < 0.001$ from each other and the most liked flavored olive oil was the one prepared with natural oregano aroma.

ACKNOWLEDGEMENTS

This study was part of a MSc. dissertation of H. Hande Akçar, supported by Ege University Scientific Research Project (Project No: 08 MÜH 011).

REFERENCES

1. EEC. 2003. Characteristics of olive and olive pomace oils and their analytical methods. Regulation EEC/1989/2003. *Offic. J. Eur. Commun.* 295: 57–66.

2. Gambacorta G, Faccia M, Pati S, Lamacchia C, Baiano A, La Notte E. 2007. Changes in the chemical and sensorial profile of extra virgin olive oils flavored with herbs and spices during storage. *J. Food Lipids* 14: 202–215.

3. Nouhad A, Tsimidou M. 1998. Aceites de oliva aromatizados con hierbas y especias. Ideas preconcebidas de los consumidores potenciales sobre las propiedades nutricionales y sensoriales de estos productos. *Olivae* 71: 56–62.

4. Damechki M, Sotiropoulou S, Tsimidou M. 2001. Antioxidant and pro-oxidant factors in oregano and rosemary gourmet olive oils. *Grasas Aceites,* 52 (3-4): 207-213.

5. Oil World. 2004. Oil World Annual. www. oilworld.biz, Hamburg.

6. USDA. 2004. Oilseeds: World markets and trade, Foreign Agricultural Service, Circular Series, FOP 06-04, June 2004, Washington, DC.

7. IOOC. 2004. World olive oil figures. www. internationaloliveoil.org. International Olive Oil Council, Spain.

8. Antoun N, Tsimidoub M. 1997. Gourmet olive oils: stability and consumer acceptability studies. *Food Res. Int.* 30: 131-13.

9. Baiano A, Gambacorta G, La Notte E. 2010. Aromatization of olive oil. *Transworld Res. Network* 37/661 (2).

10. McEwan JA. 1999. Comparison of sensory panels: a ring trial. *Food Quality and Preference* 10: 161-171.

11. Altuğ T, Elmacı Y. 2005. Gıdalarda Duyusal Değerlendirme, Meta Basım, Bornova-İzmir, 43-55p.

12. Santosa M, Abdi H, Guinard JX. 2010. A modified sorting task to investigate consumer perceptions of extra virgin olive oils. *Food Quality and Preference* 21: 881–892.

13. Kramer A, Twigg BA. 1984. Quality Control for the Food Industry, Vol.1. The Avi Publishing Company, Inc., Wesport, Connecticut, 120-154, 499, 505-508.

14. Stone H, Sidel JL. 1985. Sensory Evaluation Practices, Orlando, FL: Academic Press. Inc., Newyork, 1-10, 13-42, 58-86, 132-226p.

15. TS-4920. 1986. Sensory Analysis-Parallel Comparison Test. The Turkish Standards Institute Ankara, 9p.