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Research Article

Bitlis Bölgesinde Marketlerde Satılan Bazı Baharatın Mikrobiyolojik Kalitesi

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Özet: Bu çalışmada toplam 75 baharat (15 karabiber, 15 toz kırmızı biber, 15 pul kırmızı biber, 15 kimyon ve 15 sumak) örneği incelendi. Aerob mezofiller sırasıyla ortalama $1.7x10^7$, $2.7x10^6$, $1.6x10^7$, $4.1x10^5$ ve $2.1x10^7$ kob/g, Aerob spor oluşturan bakteriler sırasıyla ortalama $6.6x10^6$, $9.5x10^5$, $2.4x10^6$, $7.8x10^4$ ve $3.0x10^6$ kob/g olarak saptandı. *S. aureus* saptanamadı. Mikrokok ve stafilokoklar sırasıyla ortalama $8.3x10^3$, $7.7x10^2$, $8.9x10^2$ $2.5x10^3$ ve $4.0x10^2$ kob/g, *Enterobacteriaceae* sırasıyla ortalama $5.8x10^4$, $8.1x10^4$, $1.1x10^3$, $3.3x10^4$ ve $1.1x10^4$ kob/g olarak saptanırken koliformlar sırasıyla ortalama $1.1x10^4$, $1.3x10^4$, $4.2x10^2$, $4.5x10^3$ ve $1.0x10^3$ kob/g olarak saptandı. *E. coli* sırasıyla % 66.0, % 26.6, % 20.0, % 33.3 ve % 26.6 oranlarında saptandı. Enterokoklar sırasıyla ortalama $8.7x10^3$, $7.8x10^3$, $4.2x10^4$, $8.8x10^2$ ve $9.0x10^4$ kob/g, Maya ve küfler sırasıyla ortalama $3.8x10^5$, $1.2x10^5$, $3.4x10^6$, $4.2x10^4$ ve $1.0x10^6$ kob/g olarak saptandı. *B. cereus* ise sırasıyla ortalama $1.0x10^3$, $8.0x10^1$, $2.2x10^2$, $6.9x10^2$ ve $3.1x10^3$ kob/g olarak saptandı. Sülfit indirgeyen bakteriler karabiber, toz kırmızı biber, pul biber ve kimyon örneklerinde sırasıyla % 46.6, % 53.3, % 53.3 ve % 40.0 oranlarında ve ortalama 10^2 kob/g olarak saptanırken sumak örneklerinde sülfit indirgeyen bakteriler saptanamadı. Baharatın mikrobiyolojik sonuçları bu baharatın hijyenik kalitesinin zayıf olduğunu göstermektedir.

Anahtar Kelimeler: Mikrobiyolojik kalite, baharat.

Microbiological Quality of Some Spices Sold in The Markets of Bitlis District

Abstract: In this study, a total of 75 spice samples (15 black pepper, 15 powdered red pepper, 15 granulated red pepper, 15 cumin, and 15 sumac samples) were examined to determine the microbiological quality of spices. Aerob mesophile were found as mean $1.7x10^7$, $2.7x10^6$, $1.6x10^7$, $4.1x10^5$, and $2.1x10^7$ cfu/g, respectively. Aerob spore forming bacteria were found as mean $6.6x10^6$, $9.5x10^5$, $2.4x10^6$, $7.8x10^4$, and $3.0x10^6$ cfu/g in order. No *S. aureus* was detected. *Micrococci* and *Staphylococci* spp. were found as mean $8.3x10^3$, $7.7x10^2$, $8.9x10^2$ $2.5x10^3$, and $4.0x10^2$ cfu/g. *Enterobacteriaceae* were found as mean $5.8x10^4$, $8.1x10^4$, $1.1x10^3$, $3.3x10^4$, and $1.1x10^4$ cfu/g, whereas coliforms were counted as mean $1.1x10^4$, $1.3x10^4$, $4.2x10^2$, $4.5x10^3$, and $1.0x10^3$ cfu/g, respectively. *E. coli* was determined at the levels of 66.0 %, 26.6 %, 20.0 %, 33.3 %, and 26.6 %, respectively. *Enterococci* spp. were counted as mean $8.7x10^3$, $7.8x10^3$, $4.2x10^4$, $8.8x10^2$, and $9.0x10^4$ cfu/g respectively. Yeast and mould were as mean $3.8x10^5$, $1.2x10^5$, $3.4x10^6$, $4.2x10^4$ and $1.0x10^6$ cfu/g in order. *B. cereus* was counted as mean $1.0x10^3$, $8.0x10^1$, $2.2x10^2$, $6.9x10^2$, and $3.1x10^3$ cfu/g, respectively. Sulphite reducing bacteria were detected at the levels of 46.6 %, 53.3 %, 53.3 %, and 40.0 % in black pepper, powdered red pepper, granulated red pepper, and cumin samples mean 10^2 cfu/g, respectively, whereas no sulphite reducing bacteria were detected in sumac samples. Microbiological quality of spices indicate that some of spices examined are found to be having poor hygiene that may harbour harmful bacteria.

Key words: Microbiological quality, spices.

Introduction

Spices are very popular for their aroma and flavor and frequently used in food preparations. It is recognized now that spices and herbs fulfill more than one function in foods to which they are added. Spices have an effect on the apperence of food. In addition to enhancing flavour, certain spices prolong the storage like of foods by their antioxidative, bacteriocide and bacteriocitatic effects. Howewer, they are frequently reported to be highyl contamineted with bacteria and moulds (3,4,10,11,12,13,14,15,19). Contamineted spices may have an effect on the microbiological quality of end product and may cause infections and toxications in humans upon consumption. There is a no microbiological standarts published by the Turkish Standards Institute (TSE) on spices, even though the Ministry of Agriculture issued a notification (issue no: 24126) published in the offical gazete in July 2000. Therefore, the object this work was evaluate the microbiological quality of black paper,granulated red pepper, powdered red pepper, cumin and sumac samples used Widely By Consumers From All Socioeconomics Groups.

Materials and Methods

In this study, a total of 75 samples of spices were examined to determine the microbiological quality of spices. Black pepper, powdered red pepper, granulated red pepper, cumin and sumac samples (200 g) were collected from food retailers in sterile glass jars in quantities of 15 samples for each spice. Microbiological methods that are stated in the Compendium of Methods for the

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Microbiological Examination of Foods [20] and by Food and Drug Administration were used (2). Samples were transfered to laboratory aseptically and examined microbiologically at arrival. Ten g of samples were added into 90 ml peptone water and were homogenised for 2 min using a stomacher (Bagmixer). After homogenisation, and 10 fold serial dilutions up to 10^4 times with peptone water, adequate samples were inoculated on/ in relevant broth or agar media. To isolate and identify *E.coli*, Lauryl Sulfate Broth (Merck 1.10266) was inoculated and incubated aerobically at 37°C for 24-48 h. Gas production in durhaim tubes and apperance of turbidity were observed. These samples were inoculated into EC broth (Difco 0314-01-0) and were incubated at 44.5°C for 24-48 h. After incubation, samples that showed gas production and turbidity were inoculated on to Endo Agar (Oxoid CM479) and incubated at 37°C for 24-48 h. Then, IMVIC test was performed on the colonies with shiny-metalic colour. Drop method was used to inoculate agar plates. Aerob mesophiles and Aerob sporeforming mesophiles were determined using Plate Count Agar (Oxoid CM325), with incubation at 30°C for 24-48 h. *Enterobacteriaceae* counts were performed on Violet Red Bile Glucose Agar (Oxoid CM485) which was incubated aerobically at 37°C for 24-48 h. Pink-red colour colonies with precipitation were taken into consideration. *Enterococci* spp. were counted on Slanetz and Bartley Medium (Oxoid CM377) and incubated aerobically at 37°C for 24-48 h. Red colonies were taken into consideration. *Staphylococci* and *Micrococci* spp. were isolated on Baird-Parker Agar (Oxoid CM275 Egg yolk tellurite, Oxoid, SR54+) aerobically at 37°C for 24-48 h. Typical black colonies with zones around were considered as *Staphylococci* spp. Small, brown-black colonies without zones around were considered as *Micrococci* spp. For the enumeration of *Staphylococci* spp. isolated colonies as *Staphylococci* spp. were inoculated into Brain Heart Infusion Broth (Merck 1.10493), and were incubated at 37°C for 24-48 h. Subsequently, coagulase test (Merck 1.3306) was performed to distinguish coagulase positive *Staphylococci* spp. and these isolates were then inoculated onto DNase Agar (Merck 1.10449) for the identification of *S. aureus* which was confirmed by cell morphology, Gram reaction, catalase activity, sensivity to lysostaphin. *Bacillus cereus* was isolated on Cereus Selective Agar (Merck 1.05267) aerobically at 30°C for 24-48 h. Pink-purple, opaque colonies were chosen for further examination (Gram stain, catalase test, motility test, nitrat reduction, tyrosine decomposition, anaerob fermentation of glucose, Voges Proskauer reaction, production of acid from mannitol and arabinose). To isolate sulphite reducing anaerobs, Tryptose Cycloserin Agar (Merck 1.11972) was inoculated and incubated at 37°C for 24-48 h. Colonies with black zone were taken into consideration. Rose Bengal Chloramphenicol Agar (Oxoid, CM549) was used to isolate yeast-mould and incubated anaerobically at 30°C for 4-5 days. The results ($1og_{10}$ numbers) were analyzed istaticaly using one-way Annova test.

Results

The results obtained in this study are summarised in Table 1. Aerob mesophile bacteria were found at the average numbers of $1.7x10^7$, $2.7x10^6$, $1.6x10^7$, $4.1x10^5$, and $2.1x10^7$cfu/ in the black pepper, powdered red pepper, granulated red pepper, cumin, and sumac samples, respectively. The average numbers of spore forming aerob microorganisms were $6.6x10^6$, $9.5x10^5$, $2.4x10^6$, $7.8x10^4$, and $3.0x10^6$ cfu/g in the samples of black pepper, powdered red pepper, granulated red pepper, cumin, and sumac, respectively.

Table 1. The logaritmic counts (log_{10}) of detected microorganism from spices samples.

Type of spice	Parameter	Aerob mesophiles	Aerob sporeforming bacteria	*Micrococci* and *Staphylococci* spp.	*Enterobacteriaceae* spp.	Coliform	*Enterococci* spp.	Yeast and Mould	*B* cereus
Black pepper	$\bar{x}$	7.23	6.82	3.92	4.76	4.04	3.94	5.58	3.00
	Min.	5.00	4.00	2.30	3.25	2.00	2.30	3.78	2.30
	Max.	7.96	7.90	4.90	5.66	5.00	4.80	5.98	3.89
Red pepper	$\bar{x}$	6.43	5.97	2.88	4.91	4.11	3.89	5.07	1.09
	Min.	3.91	3.25	2.30	3.00	2.30	2.30	3.00	2.30
	Max.	6.97	6.90	3.80	5.80	4.92	4.94	5.88	2.60
Granulated red pepper	$\bar{x}$	7.20	6.38	2.95	3.04	2.62	4.62	6.53	2.34
	Min.	3.30	3.00	3.41	2.30	2.30	3.30	3.78	2.30
	Max.	7.94	7.38	3.60	3.90	3.60	5.30	6.99	2.90
Cumin	$\bar{x}$	5.61	4.89	3.47	4.52	3.65	2.94	4.62	2.84
	Min.	3.66	3.00	2.30	2.30	2.30	2.30	2.30	2.30
	Max	5.99	5.78	3.98	4.98	3.98	3.98	4.98	3.83
Sumac	$\bar{x}$	7.32	6.47	2.60	4.04	3.00	4.95	6.00	3.47
	Min.	4.07	4.00	2.30	2.30	2.30	3.00	3.30	3.38
	Max.	7.99	7.07	3.60	4.90	3.60	5.80	6.87	3.93

$\bar{x}$: mean
n: 15 for each spice
$s_{\bar{x}}$: 0.01-0.1

Discussion

In the studies conducted in Turkey, Uner and Ergun [18] analyzed packed and unpacked black pepper, powdered red pepper, granulated red pepper, and cumin samples and reported the average counts of $4.1x10^5$, $4.5x10^6$, $7.0x10^6$, and $3.9x10^5$ cfu/g of total mesophile bacteria in the packed samples and the average numbers of $8.9x10^7$, $3.6x10^6$, $2.6x10^7$, and $9.0x10^6$ cfu/g of total mesophile bacteria in the unpacked samples, respectively. Erol et al. [6] reported the presence of 10^6, 10^6, 10^5, and 10^4 cfu/g of total mesophile bacteria in black pepper, powdered red pepper,

granulated red pepper, and cumin samples, respectively, whereas 10^6, 10^5, 10^5, and 10^3 cfu/g of spore forming bacteria were counted in same samples, respectively. Filiz (7) counted total aerob mesophile bacteria at the average numbers of $3.9x10^7$, $8.1x10^6$, and $2.8x10^6$ and spore forming bacteria at the average numbers of $2.7x10^5$, $1.2x10^5$, and $7.7x10^4$ cfu/g in black pepper, powdered red pepper, and cumin samples, respectively. Tekinsen and Sarigol (16) found total aerob mesophile bacteria at the average numbers of 10^6, 10^6, and 10^4 cfu/g in black pepper, powdered red pepper, and cumin samples, respectively. They counted spore forming aerob bacteria at the average numbers of 10^6, 10^5, and 10^3 cfu/g in same samples, respectively. Schwab et al. [15] reported $5.0x10^5$ and $1.0x10^5$ cfu/g of total aerob mesophile bacteria in their black pepper, and red pepper samples, respectively. Vajdi and Pereira (19) counted total aerob mesophile bacteria in black pepper, and red pepper samples in the range of $4.7x10^4$-$9.8x10^7$ cfu/g and $9.0x10^2$-$1.5x10^6$ cfu/g, respectively. Satchell et al. (14) reported total aerob mesophile bacteria in the range of 10^4-10^7 cfu/g in black pepper samples whereas Kneifel and Berger (10) reported 10^7 cfu/g of total aerob mesophile bacteria in their black pepper samples. Bhat et al. (4) analyzed cumin samples, and total aerob mesophile bacteria were counted in the range of $1.0x10^4$-$1.0x10^8$ cfu/g. Our results and these studies indicate that aerob meshophile and aerob spore forming bacteria dominate microflora of these spices. Lower levels of these bacteria in cumin samples may be related to its antibacterial effects (4).

Staphylococci and *Micrococci* spp. were counted at the average numbers of $8.3x10^3$, $7.7x10^2$, $8.9x10^2$, $2.5x10^3$, and $4.0x10^2$ cfu/g in black pepper, powdered red pepper, granulated red pepper, and cumin samples, respectively. No *S. aureus* could be isolated. Erol et al. (6) reported *Staphylococci* and *Micrococci* spp. at the average counts of 10^2, 10^3, 10^3 and 10^2 cfu/g in black pepper, powdered red pepper, granulated red pepper, and cumin samples respectively whereas Tekinsen and Sarigöl (16) counted the average numbers of $1.1x10^5$, $2.8x10^5$ and $4.3x10^3$ cfu/g in black pepper, powdered red pepper, and cumin samples, respectively. Similarly, Filiz (7) stated the presence of *Sytaphylococci* and *Micrococci* spp. in the black pepper, powdered red pepper, and cumin samples at the average numbers of $3.3x10^6$, $1.0x10^6$ and $9.8x10^4$ cfu/g, respectively. Results obtained in this study regarding the numbers of *Staphylococci* and *Micrococci* spp. show similarity with the results reported by Erol et al. (6) but are lower than those reported by Tekinsen and Sarigol (16) and Filiz (7). No isolation of *S. aureus* showed similarity with other studies (4, 9), and absence of *S. aureus* indicated good personal hygiene during preparation of spices in this study.

Coliform group microorganisms in black pepper, powdered red pepper, granulated red pepper, cumin, and sumac were found to be at the average numbers of $1.1x10^4$,$1.3x10^4$, $4.2x10^2$, $4.5x10^3$, and $1.0x10^3$ cfu/g, respectively. *E. coli* was identified at the levels of 66.6 %, 26.6 %, 20.0 %, 33.3 %, and 26.6 % in the black pepper, powdered red pepper, granulated red pepper, cumin, and sumac samples, respectively. Uner and Ergun (18) counted coliform group bacteria at the average numbers of $6.4x10^4$ $3.3x10^4$, $2.3x10^4$, and $1.2x10^4$ cfu/g in unpacked black pepper, powdered red pepper, granulated red pepper, and cumin samples and $8.2x10^3$, $6.2x10^3$, $<2.0x10^2$ and $4.4x10^4$ cfu/g in packed samples, respectively. Tekinsen and Sarigöl (16) reported the presence of coliform group bacteria in black pepper, powdered red pepper, and cumin samples at the average numbers of $9.3x10^5$, $1.9x10^5$, and $4.3x10^3$ cfu/g, respectively, whereas Filiz (7) reported the average numbers of $4.9x10^3$, $1.7x10^2$ and $2.4x10^4$ cfu/g of coliforms in black pepper, powdered red pepper, and cumin samples, respectively. Erol et al. (6) found coliforms in their black pepper, powdered red pepper, granulated red pepper, and cumin samples at the average numbers of 10^3, 10^3, $<10^2$, and 10^2, respectively. Kivanc and Sert (9) isolated coliforms at the average numbers of 10^3-10^4 cfu/g in 33.0 % of black pepper, 10^1 cfu/g in 53.0 % of powdered red pepper, and in 87.0 % of cumin samples. However, Schwab et al. (15) reported very low levels of coliforms and *E. coli* (3-19 cfu/g) in their black pepper and powdered red pepper samples. This variations may be related to the different origions of spices, conditions of proccessing and storage, type of spice (powdered or granulated), and being packeed or unpacked.

In this study, yeast and mould were counted in black pepper, powdered red pepper, granulated red pepper, and cumin samples at the average levels of $3.8x10^5$, $1.2x10^5$, $3.4x10^6$, $4.2x10^4$, and $1.0x10^6$ cfu/g, respectively. Erol et al. (6) reported yeast-mould in their black pepper, powdered red pepper, granulated red pepper, and cumin samples at the average numbers of 10^3, 10^3, 10^3, and 10^3 cfu/g, respectively. Uner and Ergun (18) found yeast-mould at the average numbers of $1.1x10^5$, $4.4x10^3$, $1.1x10^3$, and $5.8x10^3$ cfu/g in

unpacked black pepper, powdered red pepper, granulated red pepper, and cumin samples; $3.7x10^4$, $1.5x10^4$, $4.0x10^3$, and $1.1x10^5$ cfu/g in packed samples, respectively. Tekinsen and Sarigöl (16) counted yeast-mould in their black pepper, powdered red pepper, and cumin samples at the average numbers of $6.9x10^4$, $2.4x10^3$, and $2.0x10^3$ cfu/g, respectively whereas Filiz (7) reported the presence of yeast-mould at the average numbers of $1.3x10^4$, $5.1x10^2$, and $2.6x10^3$, respectively. Flannigan and Hui (8) counted yeast- fungi in black pepper at the average numbers of $6.4x10^5$, cfu/g whereas Powers et al. (12) reported $1.0x10^2$cfu/g of yeast-mould in powdered red pepper. Kıvanc and Sert (9) found yeast-mould in all samples of black pepper, powdered red pepper, granulated red pepper, and 73.3 % of cumin samples at the average numbers of $1.0x10^4$ cfu/g. The results obtained in our study are higher than those obtained by other researchers (6,8,9).

B. cereus was counted in black pepper, powdered red pepper, granulated red pepper, cumin, and sumac samples at the average numbers of $1.0x10^3$, $8.0x10^1$, $2.2x10^2$, $6.9x10^2$, and $3.1x10^3$ cfu/g, respectively. Uner and Ergun [9] reported *B. cereus* in unpacked black pepper, powdered red pepper, granulated red pepper, and cumin samples at the average numbers of $1.8x10^2$, $3.9x10^2$, $3.8x10^2$, and $1.3x10^2$ cfu/g, respectively. They reported $4.0x10^2$, $3.7x10^2$, $3.6x10^2$, and $4.0x10^2$ of *B. cereus* in packed samples, respectively. Erol et al. (6) found *B. cereus* in their black pepper, powdered red pepper, granulated red pepper, and cumin samples at the average numbers of 10^2 cfu/g whereas Temelli and Anar (17) examined unpacked and packed samples of black pepper, powdered red pepper, granulated red pepper, and cumin. They reported the average numbers of $8.5x10^3$, $4.8x10^2$, $9.8x10^2$, and $1.6x10^4$ of *B. cereus* in unpacked and $2.9x10^5$, $7.7x10^4$, $2.2x10^5$, and $3.1x10^5$ cfu/g of *B. cereus* in packed samples, respectively. Agaoglu et al. (1) counted the average numbers of $2.6x10^2$, $6.3x10^2$, $3.4x10^2$, and $6.0x10^2$ of *B. cereus* in unpacked and $7.7x10^2$, $3.9x10^2$, $2.8x10^2$, and $1.0x10^3$ cfu/g in packed samples, respectively. Pafumi (11) found *B. cereus* in powdered red pepper samples in the range of $1.0x10^2$-$1.0x10^5$ cfu/g whereas Powers et al. (13) found *B. cereus* in the 53.0 % samples of powdered red pepper in the range of $5.0x10^1$-$8.5x10^3$ cfu/g. Also, Baxter and Halzaptel (3) reported the presence of *B. cereus* in analyzed 36 different spices. Our results indicate that the spices examined in this study may not pose a health risk in terms of *B.cereus* since in all reported food poisoning cases, the infective dose of *B. cereus* was greater than 100.000 organisms per gram of food

In this study, Sulphite reducing anaerobs were determined at the levels of 46.6 % (7), 53.3 % (8), 53.3 % (8), and 40.0 % (6) in black pepper, powdered red pepper, granulated red pepper, and cumin samples at the average numbers of 10^2 cfu/g, respectively. No sulphite reducing anaerobes could be determined in sumac samples. Likewise, Pafumi (11) reported the presence of *C. Perfringens* in powdered red pepper samples, and Powers et al. (6) found *C. Perfringens* in their powdered pepper samples at the level of 20 %. Also, Kneifel and Berger (10) counted *Enterococci* spp. in black pepper samples at the average numbers of $2.2x10^5$ cfu/g.

In conclusion, most spices are the products of countries with hot and moist weather. They are open to contamination with different kind of bacteria which may cause to important infections and intoxications. In our study, high numbers of bacteria were counted in analised spice samples. Considering the use of spices widely in meals such as raw meat balls (Cig kofte, fermented sausage) which is a traditional uncooked meals in Turkey, black pepper, powdered red pepper, granulated red pepper, cumin and sumac may carry a risk of contamination to humans. Even though, there is a notification issued in 2000 by the Ministry of Turkish Agriculture. There is no microbiological standards established by the Turkish Standards Institute in Turkey. Comparing our results to the limits in this notification, all of the specis analysed in this study are acceptable based on the numbers of *B.cereus* and *S. aureus* and the numbers of sulphite reducing anaerobs for sumac, however considering the numbers of total aerob mesophiles, sulphite reducing anaerobs (except sumac) and yeast-mould (except 1 cumin sample) analysed spice samples did not fit into the criteria stated in the notification mention above. Additionally, this notification does not include any criterias for spore forming aerob bacteria, *Micrococci* and *Staphylococci*, *Enterobacteriaceae*, coliform and *Enterococci* spp.

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unpacked black pepper, powdered red pepper, granulated red pepper, and cumin samples; $3.7x10^4$, $1.5x10^4$, $4.0x10^3$, and $1.1x10^5$ cfu/g in packed samples, respectively. Tekinsen and Sarigöl (16) counted yeast-mould in their black pepper, powdered red pepper, and cumin samples at the average numbers of $6.9x10^4$, $2.4x10^3$, and $2.0x10^3$ cfu/g, respectively whereas Filiz (7) reported the presence of yeast-mould at the average numbers of $1.3x10^4$, $5.1x10^2$, and $2.6x10^3$, respectively. Flannigan and Hui (8) counted yeast- fungi in black pepper at the average numbers of $6.4x10^5$, cfu/g whereas Powers et al. (12) reported $1.0x10^2$cfu/g of yeast-mould in powdered red pepper. Kıvanc and Sert (9) found yeast-mould in all samples of black pepper, powdered red pepper, granulated red pepper, and 73.3 % of cumin samples at the average numbers of $1.0x10^4$ cfu/g. The results obtained in our study are higher than those obtained by other researchers (6,8,9).

B. cereus was counted in black pepper, powdered red pepper, granulated red pepper, cumin, and sumac samples at the average numbers of $1.0x10^3$, $8.0x10^1$, $2.2x10^2$, $6.9x10^2$, and $3.1x10^3$ cfu/g, respectively. Uner and Ergun [9] reported *B. cereus* in unpacked black pepper, powdered red pepper, granulated red pepper, and cumin samples at the average numbers of $1.8x10^2$, $3.9x10^2$, $3.8x10^2$, and $1.3x10^2$ cfu/g, respectively. They reported $4.0x10^2$, $3.7x10^2$, $3.6x10^2$, and $4.0x10^2$ of *B. cereus* in packed samples, respectively. Erol et al. (6) found *B. cereus* in their black pepper, powdered red pepper, granulated red pepper, and cumin samples at the average numbers of 10^2 cfu/g whereas Temelli and Anar (17) examined unpacked and packed samples of black pepper, powdered red pepper, granulated red pepper, and cumin. They reported the average numbers of $8.5x10^3$, $4.8x10^2$, $9.8x10^2$, and $1.6x10^4$ of *B. cereus* in unpacked and $2.9x10^5$, $7.7x10^4$, $2.2x10^5$, and $3.1x10^5$ cfu/g of *B. cereus* in packed samples, respectively. Agaoglu et al. (1) counted the average numbers of $2.6x10^2$, $6.3x10^2$, $3.4x10^2$, and $6.0x10^2$ of *B. cereus* in unpacked and $7.7x10^2$, $3.9x10^2$, $2.8x10^2$, and $1.0x10^3$ cfu/g in packed samples, respectively. Pafumi (11) found *B. cereus* in powdered red pepper samples in the range of $1.0x10^2$-$1.0x10^5$ cfu/g whereas Powers et al. (13) found *B. cereus* in the 53.0 % samples of powdered red pepper in the range of $5.0x10^1$-$8.5x10^3$ cfu/g. Also, Baxter and Halzaptel (3) reported the presence of *B. cereus* in analyzed 36 different spices. Our results indicate that the spices examined in this study may not pose a health risk in terms of *B.cereus* since in all reported food poisoning cases, the infective dose of *B. cereus* was greater than 100.000 organisms per gram of food

In this study, Sulphite reducing anaerobs were determined at the levels of 46.6 % (7), 53.3 % (8), 53.3 % (8), and 40.0 % (6) in black pepper, powdered red pepper, granulated red pepper, and cumin samples at the average numbers of 10^2 cfu/g, respectively. No sulphite reducing anaerobes could be determined in sumac samples. Likewise, Pafumi (11) reported the presence of *C. Perfringens* in powdered red pepper samples, and Powers et al. (6) found *C. Perfringens* in their powdered pepper samples at the level of 20 %. Also, Kneifel and Berger (10) counted *Enterococci* spp. in black pepper samples at the average numbers of $2.2x10^5$ cfu/g.

In conclusion, most spices are the products of countries with hot and moist weather. They are open to contamination with different kind of bacteria which may cause to important infections and intoxications. In our study, high numbers of bacteria were counted in analised spice samples. Considering the use of spices widely in meals such as raw meat balls (Cig kofte, fermented sausage) which is a traditional uncooked meals in Turkey, black pepper, powdered red pepper, granulated red pepper, cumin and sumac may carry a risk of contamination to humans. Even though, there is a notification issued in 2000 by the Ministry of Turkish Agriculture. There is no microbiological standards established by the Turkish Standards Institute in Turkey. Comparing our results to the limits in this notification, all of the specis analysed in this study are acceptable based on the numbers of *B.cereus* and *S. aureus* and the numbers of sulphite reducing anaerobs for sumac, however considering the numbers of total aerob mesophiles, sulphite reducing anaerobs (except sumac) and yeast-mould (except 1 cumin sample) analysed spice samples did not fit into the criteria stated in the notification mention above. Additionally, this notification does not include any criterias for spore forming aerob bacteria, *Micrococci* and *Staphylococci*, *Enterobacteriaceae*, coliform and *Enterococci* spp.

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