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THE INVESTIGATION OF SOME MICROBIOLOGIC CHARACTHERISTICS OF BRANDED AND NON-BRANDED SAUSAGES CONSUMED IN KONYA, TURKEY

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ABSTRACT

In this study, some microbiologic characteristics [TAMB (Total Aerobic Mesophilic Bacteria) count, coliform bacteria count, Staphylococcus aureus count, mold and yeast counts] of total 48 branded and non-branded sausage to be marketed in Konya were determined. TAMB counts were $1x10^7$cfu/g-$6.8x10^6$cfu/g, coliform bacteria counts were $3.0x10^1$cfu/g-$1.4x10^3$cfu/g, mold and yeast counts were $1.0x10^1$cfu/g-$1.1x10^1$cfu/g, S. aureus counts were $2.6x10^3$cfu/g-$2.7x10^2$cfu/g respectively in branded and non-branded sausage specimens. Results were analized with Students' t test and Mann- Whitney U tests. Coliform bacteria and S. aureus counts were statistically different between branded and non-branded sausage specimens ($p<0.05$). Statistical difference concerning TAMB counts, mold and yeast counts between branded and non-branded sausage was not different ($p>0.05$). Branded sausages, although partially meeting quality requirements, must be supported with know-how and technology to increase quality. Non-branded sausages, on the other hand, are potentially dangerous to public health and cause deceivement of consumers.

Key Words: *Sausage, Bacteria counts, Coliform, S. aureus, Yeast and mold*

KONYA'DA TÜKETİLEN MARKALI VE MARKASIZ SUCUKLARIN BAZI MİKROBİYOLOJİK KARATERLERİNİN ARAŞTIRILMASI

ÖZET

Bu çalışmada, Konya ilinde tüketime sunulan markalı ve markasız toplam 48 sucuk örneğinin bazı mikrobiyolojik karakterleri [TAMB (Toplam Aerobik Mezofilik Bakteri) sayımı, koliform bakteri sayımı, Staphylococcus aureus, küf ve maya sayımı] incelendi. Markalı ve markasız sucuk örneklerinde sırayla; TAMB sayısı 1x107cfu/g-6.8x106cfu/g, koliform bakteri sayısı 3.0x101cfu/g-1.4x103cfu/g, küf ve maya sayısı 1.0x101cfu/g-1.1x101cfu/g, S. aureus sayısı 2.6x103cfu/g-2.7x102cfu/g olarak tespit edilmiştir. Sonuçlar istatiksel olarak Students' t test ve Mann- Whitney U test ile analiz edilmiştir. Koliform bakteri ve S.aureus sayıları markalı ve markasız sucuk örnekleri arasında istatistiki fark bulunmuştur ($p>0.05$). Markalı ve markasız sucuklar arasında küf ve maya sayıları ile TAMB sayıları arasında istatistiki olarak anlamlı bir fark gözlenmemiştir ($p<0.05$). Kısmen kalite gereksinimi ile karşılmasına rağmen, markalı sucukların kalitesinin artırılması için teknoloji ve teknik becerilerle desteklenilmelidir. Diğer yandan markasız sucuklar halk sağlı açısında potansiyel bir tehlike olmakla birlikte tüketicilerin adatılmasına neden olmaktadır.

Anahtar Kelimeler: *Sucuk, Bakteri sayımı, Koliform, S. aureus, Maya, Küf*

INTRODUCTION

Meat besides being rich in nutrional elements, minerals and developmental factors, also represent a suitable media for the proliferation of several microorganisms (Sarpkaya, 2000). Several methods were developed taste and aroma of meat (Sinell, 1981; Gökalp et al., 1994). Sausage is produced the most commonly and consumed fermented meat product in Turkey, although being similar to salami and sausage produced in Europe, is a fermented meat product spesific to Turks (Gökalp et al., 1994).

Turkish sausage is produced from torso meats of healthy animals slaugthered in legal slaugtherhouses or factories. Sausage a fermented produce of pulp made of mixture of meat with appropriate amounts of salts, flavored supplements, and starters; filled in natural or artificial covers and left for maturation and fermentation (Anonim, 2002). Starter cultures that are first used in 1961 for production of fermented meat products have been widely used (Geisen et al., 1992; Gökalp, 1984; Tayyar, 1993).

Sausage must be physically, chemically and microbiologically non-hazardous to human health (Gökalp et al., 1994). Meats for sausage must be suited to standarts and have no internal organs and connective tissue (Erc). Some investigators recommend that histological examinations of sausage for the investigation of internal organs and connective tissue may yield healthier results (Uğurlu, 1991; Sarıgöl, 1985).

Quality controls of sausage are obliged to be performed according to sensorial, chemical, microbiologic, serological spesifics and toxicological examination criteria (Anonim 2002). This causes appearance in the market of several sausages being different in their chemical, physical and microbiologic characteristics (Çon et al., 2002; Nazlı and Şenol, 1997).

Large capacity companies producing meat and meat products in our region, although concentrated generally in cities like Afyon, Cankiri, Erzurum, Istanbul, Izmir, Kayseri and Van, are also found in

low numbers in all other territories (Kolsarıcı and Atıcı, 1995). Most branded sausages produced by big companies are marketed in superstores and delicatessens. Besides big companies, local butchers also play important roles in production numbers of fermented Turkish sausage. These sausages, generally non-branded, produced by small companies and local butchers, are marketed in the same areas they were produced. Quality controls of branded sausages are done by the company laboratory and also in the laboratories of Turkish Standarts Institute (TSI) and Ministery of Health and Ministery of Agriculture. Controls of non-branded sausages produced by small companies and butchers are made effectively.

Some producers use non-qualified or spoiled meats, low quality supplements and internal organs for the production of sausage. This results in unjust competition against companies making production suitable to standarts, deceivement of consumers and production of meat products hazardous to human health (Atasever et al., 1999). In this study, we aimed to investigate some microbiological characteristics of sausages marketed in local bazaars and stores to observe if there are differences.

MATERIAL METHODS

Twenty-four branded sausage specimens were bought from stores and delicatessens, and non-branded 24 sausage specimens were bought from local bazaars and butchers, in Konya. Twenty-five grams of sausage specimen were drawn from original cover with the help of a sterile spatule and delivered into special bag of stomacher with 225 ml of serum physiologic. This mixture was homogenized at 10000-20000 rpms/min, in 2 min. Dilutions to the level of 8-10 were prepared and two 0.1 ml samples were prepared on glass plates for each single count (APHA, 1992; Anonim). After incubation of specimens in Plate Count Agar (oxoid) at 35 ºC for 48 h., Total Aerobik Mesophylic Bacteria (TAMB) counts (APHA, 1992; Harrigan, 1998; Gökalp et al., 1993); coliform bacteria counts after incubation in Violet Red Bile Dextrose Agar (oxoid) at 37 ºC for 24 h. (3,16); *Staphylococcus aureus* counts after incubation in Staphylococcus medium 110 (oxoid) at 37 ºC for 24 h. (3,13); total yeast and mold counts after incubation in Potato Dextrosa Agar (pH 3.5) (oxoid) at 25ºC for 5 days, were performed (APHA, 1992; Gökalp et al., 1993).

Statistical analysis: Data obtained in this study were analized with Student's T-test if groups are normal dispersion. Mann-Whitney U test was used for groups not fitting to normal dispersion. Results of microbiologic counts used in statistical analysis were transformed to logorhytmic unit (log10) (Sümbüloğlu, 1990).

RESULTS

To assay microbiologic quality of branded and non-branded sausage specimens in this study, the count of TAMB, coliform bacteria, *S. aureus* and mold and yeast were done (Table 1).

Table 1: Microbiologic counts in branded and non-branded sausages

Sample	TAMB count		Coliform Bacteria count		*S. aureus* count		Yeast and Mold count	
Number	Branded	Non-branded	Branded	Non-branded	Branded	Non-branded	Branded	Non-branded
1	$2.4x10^8$	$2.7 x10^9$	$1.3 x10^1$	$2.3 x10^3$	$2.4 x10^5$	$2.1 x10^4$	$1.4 x10^4$	$3.8 x10^3$
2	$9.8 x10^7$	$6.7 x10^8$	<10	$4.1 x10^3$	$1.1 x10^4$	$3.2 x10^3$	$2.2 x10^3$	<10
3	$3.5 x10^6$	$7.6 x10^7$	<10	$2.7 x10^4$	$1.3 x10^3$	$3.4 x10^3$	$2.9 x10^2$	$2.1 x10^2$
4	$4.2 x10^7$	$5.6 x10^6$	$2.1 x10^2$	$1.4 x10^4$	$3.5 x10^3$	$7.2 x10^2$	$1.2 x10^3$	$4.0 x10^1$
5	$3.2 x10^6$	$3.9 x10^6$	$8.0 x10^2$	$3.2 x10^3$	$3.7 x10^3$	$9.0 x10^2$	$4.1 x10^1$	$5.4 x10^2$
6	$5.8 x10^4$	$4.8 x10^8$	<10	$2.1 x10^4$	$1.5 x10^2$	$2.9 x10^3$	$9.1 x10^3$	<10
7	$6.8 x10^5$	$8.2 x10^7$	<10	$3.4 x10^3$	$4.0 x10^2$	$7.3 x10^2$	$8.2 x10^2$	$1.5 x10^1$
8	$6.2 x10^7$	$9.2 x10^6$	$0.8 x10^2$	$2.6 x10^3$	$0.2 x10^2$	$2.2 x10^3$	$7.4 x10^3$	$6.2 x10^4$
9	$3.4 x10^6$	$7.3 x10^5$	$2.3 x10^1$	$1.9 x10^2$	$1.4 x10^4$	$1.2 x10^1$	$5.6 x10^4$	$3.3 x10^2$
10	$2.4 x10^8$	$8.4 x10^6$	$3.2 x10^2$	$2.9 x10^3$	$2.3 x10^4$	$2.5 x10^2$	$2.8 x10^2$	$4.1 x10^1$
11	$4.0 x10^6$	$9.4 x10^4$	$5.6 x10^1$	<10	$2.5 x10^2$	$1.0 x10^1$	$2.4 x10^2$	$2.8 x10^2$
12	$2.6 x10^7$	$6.9 x10^7$	$8.3 x10^1$	$3.5 x10^4$	$2.6 x10^3$	$1.4 x10^2$	$2.5 x10^4$	$5.1 x10^1$
13	$9.6 x10^5$	$8.0 x10^6$	$2.6 x10^3$	$3.0 x10^3$	$3.8 x10^4$	$2.0 x10^2$	$3.8 x10^2$	$2.0 x10^1$
14	$7.4 x10^6$	$7.8 x10^5$	$2.1 x10^1$	$7.2 x10^2$	$4.2 x10^3$	$5.4 x10^1$	$1.5 x10^2$	$2.7 x10^2$
15	$4.8 x10^7$	$4.6 x10^6$	<10	$8.1 x10^3$	$6.4 x10^5$	$3.6 x10^2$	$4.2 x10^3$	<10
16	$9.4 x10^5$	$3.1 x10^7$	<10	$9.0 x10^3$	$3.2 x10^3$	$4.2 x10^2$	$5.1 x10^2$	$2.2 x10^3$
17	$2.9 x10^7$	$4.5 x10^6$	$2.1 x10^1$	$3.8 x10^3$	$4.8 x10^5$	$1.1 x10^2$	$9.0 x10^2$	$5.1 x10^2$
18	$3.1 x10^8$	$3.4 x10^6$	<10	$2.5 x10^2$	$7.4 x10^4$	$9.0 x10^1$	<10	$3.6 x10^3$
19	$3.4 x10^7$	$5.9 x10^5$	$1.0 x10^1$	$1.1 x10^2$	$3.5 x10^2$	$8.7 x10^1$	$8.7 x10^1$	$9.1 x10^3$
20	$6.5 x10^5$	$8.5 x10^5$	<10	<10	$3.1 x10^1$	$6.3 x10^1$	$3.6 x10^3$	$8.0 x10^1$
21	$8.2 x10^6$	$9.9 x10^5$	$1.2 x10^1$	$4.1 x10^3$	$2.3 x10^1$	$2.6 x10^2$	$3.9 x10^2$	$2.9 x10^2$
22	$3.7 x10^7$	$9.4 x10^4$	<10	<10	$2.9 x10^2$	$8.1 x10^1$	<10	<10
23	$5.8 x10^6$	$7.2 x10^5$	<10	$6.2 x10^3$	$3.4 x10^3$	$7.0 x10^2$	$2.7 x10^1$	$2.2 x10^2$
24	$8.4 x10^6$	$6.9 x10^6$	$4.2 x10^1$	$6.4 x10^2$	$4.2 x10^2$	$1.5 x10^1$	$7.3 x10^1$	$1.4 x10^2$
$\bar{x}$	$1.0 x10^7$	$6.8 x10^6$	$3.0 x10^1$	$1.4 x10^3$	$2.6 x10^3$	$2.7 x10^2$	$1.0 x10^1$	$1.1 x10^1$

TAMB count in branded sausage specimens were between $5.8x10^4$-$3.1x10^8$ cfu/g (mean$1.0x10^7$ cfu/g). TAMB counts in non-branded specimens were between $9.4x10^4$-$2.7x10^9$cfu/g (mean $6.8x10^6$ cfu/g).

There was no statistical difference between branded and non-branded sausages in terms of TAMB counts (t=0.585, p=0.561). Coliform bacteria counts in branded sausage specimens were between <10-$2.6x10^3$ cfu/g (mean $3.0x10^1$ cfu/g), in non-branded sausage specimens these counts were <10-$3.5x10^4$ cfu/g (mean$1.4x10^3$ cfu/g). There was significant difference between two groups (z=4.510, p=0.000). *S. aureus* counts in branded sausage specimens were between $2.3x10^1$-$6.4x10^5$ cfu/g (mean $2.6x10^3$ cfu/g), in non-branded sausage specimens these counts were $1.0x10^1$-$2.1x10^4$ cfu/g (mean $2.7x10^2$ cfu/g). There was significant difference between two groups (t=3.120, p=0.03). Yeast and mold counts in branded sausage specimens were between <10- $5.6X10^4$ (mean $1.0x10^1$ cfu/g), while in non-branded sausage specimens these counts were <10- $6.2x10^4$ cfu/g (mean $1.1x10^1$ cfu/g). Statistical difference between two groups was nonsignificant (Z=1.600, P=0.110).

DISCUSSION

We found lower TAMB counts in branded and non-branded sausages compared to some studies (Özer and Özalp, 1968; Aytekin, 1986; Gökalp et al., 1977; Yaman et al., 1998). On the other hand, our results are in accordance with other studies (Nazlı and Şenol, 1997; Tayyar and Başeğmez, 1993,Atasever et al., 1998; Çon and Gökalp, 1998). Generally the mean TAMB counts in sausage specimens were within 10^6-10^7cfu/g, a number recommended by some authors to be a tolerable one in matured sausage (Nazlı and Şenol, 1997; Tekinşen et al., 1982). Statistical difference of TAMB counts between branded and non-branded sausage specimens was not significant but TAMB count was slightly higher in branded than non-branded sausages. Organoleptic examinations and external appearances of branded sausages with a high TAMB count of 10^8 cfu/g were normal. Stickers of branded sausages were examined and use of starter cultures were confirmed. This was assumed to increase microbiological burden. Of seven non-branded sausage specimens with TAMB counts over 10^7cfu/g, four sausages were not suitable for consumption according to organoleptic examinations and external appearances. Sinell (Tayyar and Başeğmez, 1993) suggests that fermented sausages with a 10^6/g total microorganisms are moderately contaminated. According to this observation, high TAMB counts in sausages produced in non-hygienic environment suggests contamination.

Coliform bacteria counts in branded sausage specimens were much lower than some reports (Nazlı and Şenol, 1997; aytekin, 1986; Gökalp et al., 1988; Yaman et al., 1998; Sinell, 1981; Tayyar and Başeğmez, 1993; Kahya, 1973). These counts, on the other hand, were higher than standarts specified by TSI (TSE 1070) (Gökalp, 1984), and this poses potential hazards to public health. Counts of coliform bacteria over specified levels suggests maturation be not enough and use of faulty maturation tecniques (Tekinşen et al., 1982). Coliform bacteria counts of non-branded sausage were in accordance with reports of studies over branded sausages (Nazlı and Şenol, 1997; Aytekin, 1986; Gökalp et al., 1988; Yaman et al., 1998; Sinell, 1981; Tayyar and Başeğmez, 1993; Kahya, 1973). Significant statistical difference of coliform bacteria counts in branded and non-branded sausage show that general hygiene rules were not applied during production and contamination of raw materials.

Mean counts of *S. aureus* in branded and non-branded specimens were lower than previous reports (Atasever et al., 1998; Çon and Gökalp, 1998; Nazlı et al., 1986). Counts presented similar results with reports of Gökalp et al (Gökalp et al., 1988) and were between specified standarts ($5x10^2$-$5x10^3$cfu/g) of TSI 1070 (Anonim 2002). Statistical difference for *S. aureus* counts between two groups was significant. Higher *S. aureus* counts in branded sausages may be secondary to presence of micrococceae species in starter cultures used in branded sausages (Coretti, 1977). In this study mean yeast and mold counts were not different between branded and non-branded sausages and did not exceed specified standarts of TSI 1070 (10-10^2cfu/g) (Atasever et al., 1999), but lower than previous reports of other authors (Yaman et al., 1998; Atasever et al., 1998; Çon and Gökalp, 1998). This may be a result of different production and conditions. Although branded sausages are produced in more modern and hygienic conditions, the presence of specimens not fitting to standarts of TSI (TSE 1070) and Food Materials Regulations (Erc) indicate the necessities of better checks, elimination of contaminations rooting from environment and raw materials and supplementation of know-how and higher technology.

Non-branded sausages are produced by butchers and non-hygienic conditions. These sausages do not have any stickers that state their specifics. This is a big problem for public health and creates unjust competition against legal firms. Consumers need to be more conscious about the condition.

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