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Microbiological Attributes of Vacuum Packed Frankfurters Obtained From Local Markets in İzmir

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Abstract
In this study microbiological changes of cattle sausages that are sold in the local markets of İzmir were monitored during storage at 4°C. Aerobic Mesophilic Bacteria (AMB), Total Yeast and Mold (TYM), Lactic Acid Bacteria (LAB) and Psychrophilic Bacteria (PB) counts of frankfurters were monitored on day 0, 15, 30, 45, 60 of storage. Four different brand of cattle sausage were analyzed for this study. Total Yeast and Mold count didn't change significantly whereas Aerobic Mesophilic Bacteria and Psychrophilic Bacteria count increased approximately 2 log. Lactic acid bacteria count was increased about 1-3 log. Bad smell and slimy surface occurred on day 60 (end of the storage) implicating the spoilage of frankfurters. Results showed that the production process of the frankfurters analyzed for this study was insufficient to ensure low microbial load of the product and the counts might grow higher during storage.
Keywords: Microbial load, frankfurter, storage, vacuum packed, quality.

INTRODUCTION

Emulsion sausage is a cooked meat product that is widely consumed in Turkey. Because of its high pH and a_w the product is susceptible to spoilage during storage [1]. Even though the cooking process kills many vegetative cells [2], some might survive or post-cooking recontamination might occur [3].

In food industry it is important to evaluate the microbial loads of the end products and rearrange production steps accordingly. The aim of this study was to determine the microbial load of emulsion-type sausages sold in the markets in İzmir.

MATERIALS AND METHODS

Sausages were purchased from grocery stores on their arrival days and brought to the laboratory at 4°C. Four different brand of cattle sausage were analyzed for this study and duplicate results were obtained.

Microbiological analyses were conducted on the first day of their purchase and on day 15, 30, 45 and 60 of the storage. For microbiological analysis 25 g of samples was mixed with 225ml of sterile peptone water (0.1%) with a stomacher for 2 minutes. Serial dilutions were prepared from that dilution. Plate Count Agar (PCA) was used for AMB and PB counts. Petri dishes were incubated at 35°C for 48h for AMB and at 7°C for 7 days for PB. TYM count was made by plating on Dichloran Rose Bengal Chloramphenicol Agar (DRBC) followed by incubation at 25°C for 3-5 days. Man-Rogosa Sharpe Agar (MRS) was used for LAB count. Double layered petri dishes were incubated at 35°C for 72 h.

RESULT AND DISCUSSION

Aerobic mesophilic bacteria (AMB) count of the sausages in the beginning of the storage ranged from 3.15 to 6.09 log (log10 cfu/g) (Figure 1, Table 1). At the end of the storage AMB counts of brands A,C,D were approximately 2 log higher than in the beginning of the storage whereas AMB count didn't change significantly in the brand B during storage. AMB count of the sausages increased significantly in the first half of the storage days (except for brand B). The effect of storage time and brand-based differences were statistically significant (p<0.05).

Table 1: Aerobic Mesophilic Bacteria Count of The Sausages (4 different brands; A, B, C, D) During 60 Days Of Storage (log cfu/g ±SD)

		A	B	C	D
Days	0	4.48±0.17^{by}	3.15±0.21^{az}	6.09±0.12^{bx}	5.09±0.12^{dy}
	15	4.44±0.2^{bz}	2±0.0^{bt}	7.70±0.03^{ax}	5.83±0.19^{cdy}
	30	6.92±0.0^{axy}	3.57±0.11^{az}	7.34±0.62^{ax}	6.28±0.03^{bcy}
	45	6.89±0.02^{ay}	3.81±0.07^{az}	7.90±0.03^{ax}	6.90±0.01^{aby}
	60	6.93±0.03^{az}	3.63±0.44^{at}	8.18±0.1^{ax}	7.26±0.03^{ay}

*Same letters in the columns (a,b,c,d) and in the rows (x,y,z,t) indicate no statistically significant difference was observed (p<0.05)

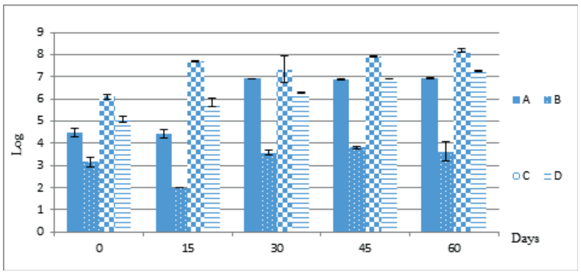

Figure 1: Aerobic Mesophilic Bacteria Change During Storage

Elmalı et.al. [4], reported lower AMB counts than the present results for both vacuum packed and non-packed emulsion-type sausages sold in Kars. They reported that AMB counts of vacuum packed sausages was under the detection limit (< 2 log) and the mean value of AMB count of unpacked sausages was $1.3x10^4$ cfu/g. Elbazidy et.al. [5] also found lower counts than our results that they reported the AMB count of emulsion-type sausages produced in eight different plants within the range of <2-1.55 log. Afshin et.al. [1] published more similar results to ours that within 5 weeks of storage, AMB count of hot smoked sausages changed from 3.23 log to 5.13 log. Bingöl&Bostan [6] reported the control group of experimentally produced sausages had 3.23 log AMB count on the 1st day of storage and increased to 5.13 log on the 60th day. Assaye&Ashenafi [7], investigated microbial load of emulsion-type dry veal sausage in Ethiopia. They reported the mean value of AMB count 5.18 log (min 3.27 log, max 7.79 log). Sachindra et.al. [2] reported the AMB count of experimentally produced sausages was 4.09 log on the 1st day of storage and 6.38 log on the last day (day 32). Balpetek [8], conducted a study to determine microbiological load of meat products collected from retail markets and local butchers in Konya. They reported that the mean value of AMB count of sausages was 5.75 log. There is reports show that the AMB count of sausages is greatly reduced by the cooking process. Güngör and Gökoğlu [9], reported that cooking process of sausages decreased AMB count from 7.02 log to 3.93 log. Sachindra et.al. [2], reported that 5.41 log AMB count of raw sausages decreased to 3.75 log of after cooking. In our study the high counts of AMB might be the result of mishandling after cooking process. AMB load shows great relevance to shelf-life of a food product. Although in our study some brands had high initial counts, the spoilage indicators (off odor, surface slime) were not observed until the last days of storage.

Table 2: Total Yeast and Mold Count of The Sausages (4 different brands; A, B, C, D) During 60 Days Of Storage (log cfu/g ±SD)

		A	B	C	D
Days	0	4.79 ± 0.45^{axy}	5.07 ± 0.11^{bx}	<1	3.85 ± 0.1^{ay}
	15	3.47 ± 0.0^{bx}	5.47 ± 0.03^{ay}	<1	3.89 ± 0.15^{ax}
	30	4.79 ± 0.05^{axy}	5.53 ± 0.1^{ax}	<1	3.97 ± 0.1^{ay}
	45	3.64 ± 0.08^{by}	5.45 ± 0.16^{ax}	<1	3.93 ± 0.04^{ay}
	60	3.45 ± 0.21^{by}	5.35 ± 0.49^{ax}	4.38 ± 0.52^{xy}	4.02 ± 0.09^{ay}

*Same letters in the columns (a,b,c,d) and in the rows (x,y,z,t) indicate no statistically significant difference was observed (p<0.05)

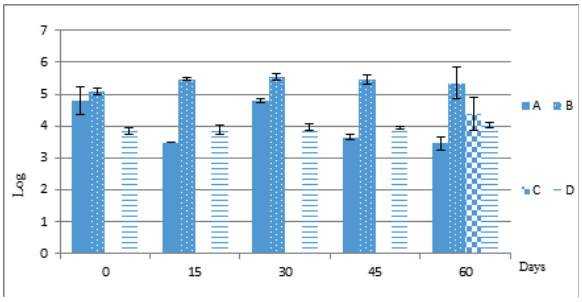

Figure 2: Total Yeast and Mold Change During Storage

Total Yeast and Mold count of the sausages were in the range of <1-5.07 log in the beginning of the storage. The brands B and D showed no significant increase in the TYAM count during storage. On the other hand brand A showed a decrease. Total yeast and mold count was observed below the detection limit for brand C until the last day of storage. Since sausages were vacuum packed, these results can be expected. But in the case of brand C we think variation between samples caused the observed results (Figure2, Table 2).

Assaye &Ashenafi [7], analyzed veal sausages and reported the mean value of TYM count as 3.30 log. Sachindra et.al. [2], reported TYM count of raw sausages 2.29 log and 0.72 log of cooked sausages (pH of 5.98–6.12 cooked). They suggested the presence of TYM could be attributed to recontamination during handling of cooked sausage. TYM counts were higher than the acceptable limit according to old Microbiological Criteria of Turkish Food Codex [10]. Recent Microbiological Criteria of Turkish Food Codex has no limit set for TYM counts of emulsion sausages [11].

Table 3: Lactic Acid Bacteria Count of The Sausages (4 different brands; A, B, C, D) During 60 Days Of Storage (log cfu/g ±SD)

		A	B	C	D
Days	0	<1	3.32 ± 0.16^{ax}	5.99 ± 0.0^{bcy}	<1
	15	2.56 ± 0.12^{byz}	3.03 ± 0.11^{ay}	5.76 ± 0.09^{cx}	1.89 ± 0.16^{bz}
	30	3.46 ± 0.04^{ay}	2.94 ± 0.14^{ayz}	6.70 ± 0.15^{bx}	2.44 ± 0.05^{bz}
	45	3.10 ± 0.46^{aby}	3.17 ± 0.12^{ay}	6.88 ± 0.04^{abx}	2.49 ± 0.27^{by}
	60	3.44 ± 0.07^{ay}	3.29 ± 0.3^{ay}	7.59 ± 0.54^{ax}	3.77 ± 0.03^{ay}

*Same letters in the columns (a,b,c,d) and in the rows (x,y,z,t) indicate no statistically significant difference was observed (p<0.05)

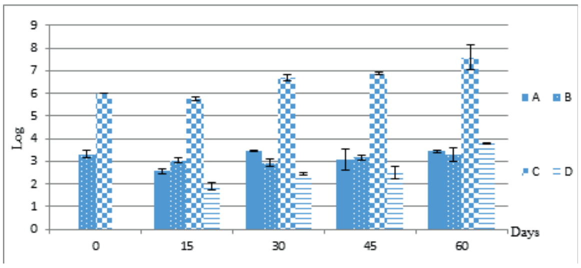

Figure 3: Lactic Acid Bacteria Change During Storage

Lactic acid bacteria (LAB) counts of the sausages ranged from <1-5.99 log in the beginning of the storage. The changes of the LAB counts throughout storage were not very significant except for brand D. LAB count of brand C were significantly higher than other brands (Figure 3, Table 3).

Lücke et.al. [12] reported an approximately 2 log increase within 9 days from 50-5600 cfu/g to 5x106 cfu/g, in emulsion-type sausages from organic meat.

Assaye&Ashenafi [7] also reported higher results of LAB count (mean value 5.31 log). Sachindra et.al. [2], found LAB count of buffalo sausage reached 5.2 log on day 32 of the storage. The authors also concluded that LAB contributes very less to the initial flora of raw sausages. Even though LAB is considered to be the main cause of spoilage of sausages, there are also studies show that LAB is not dominant in the microflora of some sausages [13].

Table 4: Psychrophilic Bacteria Count of The Sausages (4 different brands; A, B, C, D) During 60 Days Of Storage (log cfu/g ±SD)

		A	B	C	D
Days	0	5.16 ± 0.03^{ct}	5.75 ± 0.07^{bz}	6.25 ± 0.1^{cy}	6.94 ± 0.08^{bx}
	15	7.34 ± 0.0^{by}	5.8 ± 0.04^{bt}	6.3 ± 0.07^{cz}	7.94 ± 0.07^{ax}
	30	7.41 ± 0.05^{by}	5.8 ± 0.14^{bt}	6.51 ± 0.02^{bcz}	7.92 ± 0.01^{ax}
	45	7.46 ± 0.22^{by}	5.99 ± 0.06^{abt}	6.90 ± 0.03^{bz}	7.9 ± 0.01^{ax}
	60	7.94 ± 0.06^{ax}	6.35 ± 0.01^{ay}	7.98 ± 0.18^{ax}	7.83 ± 0.22^{ax}

*Same letters in the columns (a,b,c,d) and in the rows (x,y,z,t) indicate no statistically significant difference was observed (p<0.05)

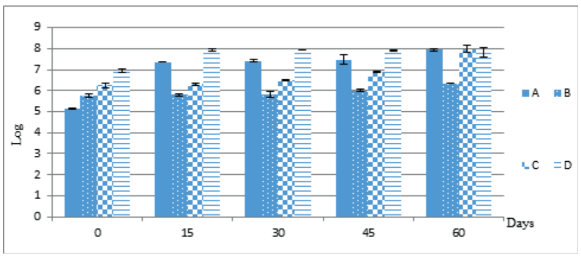

Figure 4: Psychrophilic Bacteria Change During Storage

Psychrophilic bacteria (PB) count of the sausages ranged from 5.16 log to 6.94 log on the 1st day of the storage. The counts were in range of 6.35 -7.97 log at the end of the storage. Even though PB counts seemed to gradually increase in all of brands during storage the increase was not very significant for brand B and D (Figure 4, Table 4).

Elbazidy et.al. [5], reported PB count of sausages between 0.77 log and 3.33 log. Sachindra et.al. [2] also reported lower values of PB count as ND- 3.72 log (ND:not detected).

There is little information on PB count of cooked sausages in the literature. Results of the present study show PB is dominant in the microbial flora of emulsion sausages which is expected considering the storage conditions of sausages.

The PB load of the sausages was similar at the end of the storage except for brand B. This brand of sausages showed no significant increase in the AMB, TYM and LAB load. We suspect that this brand of sausages might have had some kind of an antimicrobial additive that suppressed these microorganisms. But no analyses were conducted to confirm this idea. Also the less significant PB change of brand D might be due to the already high numbers observed at the beginning of the storage.

CONCLUSION

Emulsion-type sausages have considerably low microbial loads after cooking process. If they are handled properly after cooking process those microbial loads remain low. There is variation in the results obtained from the studies. It is most likely due to the specific post-process handling and storage conditions. Recontamination of microorganisms occurs during slicing, packaging steps and shortens the shelf-life of the product. Results of this study show there is a mishandling of these products after cooking or inadequate cooking was applied. Even though no analysis was conducted for food-borne pathogens in this study, it might be speculated that these products are also susceptible for pathogen contamination. Therefore precautions should be taken.

Acknowledgements

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