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Microbial Properties of Hot Smoked Sausage During Shelf Life

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Abstract: The Hot smoked sausage is one of most famous and most adherent Sausage. Shelf life of meat products treated by heat depends on some factors. The most important factor is the microbiological quality of raw materials. This study was made on Hot smoked sausage produced indoor without vacuum-packaging. A total of 10 samples with the same production date taken randomly from different batches were collected. These samples were studied from production time to 5th week. The total bacterial, mold and yeast, coliforms, psychrophilic microorganisms` and coagulase positive *Staphylococcus aureus* counts were performed on basis of No. 2303, 1194, 437, 997, 356 protocol of Iranian Standard Institute. The results were analyzed by paired T-test and mean of microbial counts were compared in different weeks. The results showed a significant increasing ($p<0.05$) in microbial counts in different weeks. All of the samples failed in 1st and 2nd week as they showed optimum microbial counts. No coliforms were detected in the 5 week study period. This indicates that the products had low quality for marketing.

Key words: Microbial Properties · Hot Smoked Sausage · Shelf Life

INTRODUCTION

Meat products are products that insist of at least one half of it meat. These products are one of the most consuming food products. Sausage is a popular and highly relished meat product world over. Dry Sausage produced is as a result of finding of new spices. These spices can help to improve flavor and increasing of shelf life of meat. Many kinds of Sausage are produced depending on raw material in area and different climates. Microbial growth during storage is one of the main factors affecting the quality of meat products, leading to spoilage and hence economic losses. Emulsion-type sausages like wiener, bologna-type sausage and hot smoked sausage may spoil more quickly due to high pH and aw(activity water). Many vegetative cells can be inactivated with cooking process [1, 2]. Sausage may be contaminated after heat processing and during other processes such as slicing, packaging and peeling [3, 4].

Many studies have determined the presence of food-borne pathogens in these products, such as *Listeria monocytogenes*, *Staphylococcus aureus*, *Clostridium perfringens* and *Salmonella spp*. [5] As for *L. monocytogenes*, several studies showed that emulsion-type sausage is risky, because the bacteria have high tolerance to physical conditions compared to other pathogens. Moreover, this food-borne pathogen is able to grow at refrigeration temperatures [6-7]. Thus, microbial ecology of meat products will mainly depend on the environment, kind of meat and raw materials, equipment, handling practices, processing, packaging and storage temperature. Information on microbiology of Hot smoked sausage is very limited. The objective of the study was to understand the microbial properties of Hot smoked sausage during shelf life.

MATERIALS AND METHODS

A total of 10 samples of hot smoked sausage with similar production date from different batches were collected and transported in an ice box at 4°C to laboratory of food hygiene in Islamic Azad University Tabriz branch. Study on microbial properties during shelf life from first week until 5 week was done. Culture of

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samples and identification of the suspected colonies was done according to the standard methods [8]. For microbial counts, 10 grams of each Hot smoked sausage representative sample were removed aseptically and homogenized in 90 ml of 1.5%peptone water, using a stomacher and inoculated onto plate count agar (Merck) (incubated at 37°C for 48h), using the pour-plate method and violet neutral red bile lactose agar (Merck) (incubated at 37°C for 24 h), for coliform counts. Cooked meat salt medium (Merck) and Bird Parker agar (Merck) used for coagulase positive *Staphylococcus aureus* counts (incubated at 37°C for 48h). For mold and yeast total counts, Sabaroud dextrose agar (Merck) plates incubated at 25°C for 5 days were used. Psychrophilic microorganisms' counts were carried out by use of nutrient agar (Merck) plates incubated at 5-20°C for 24h [8-12]. Data were analyzed by using SPSS (version 12) software and Paired T- test.

RESULTS

Results of this Study Were Divided to 5 Parts: Maximum permissible count for total bacteria is 10^5CFU/gm, but the microbiological analysis results of this study showed that, the count at 4th week was more than this value. By attention to results of this part during 5th weeks, total bacterial count mean comparing with those in weeks 1,2 and 3 showed significant difference ($p<0.05$) (Table 1).

Permissible count for coagulase positive *Staphylococcus aureus* is 0CFU/gm. In this study, this amount in week 1 got through the permissible range. Results of coagulase positive *Staphylococcus aureus* count means in weeks 1, 2 and 3 showed significant difference ($p<0.05$) (Table 2).

The acceptable psychrophilic microorganisms` count is 10^2 CFU/gm, but in this study, the count in first week of shelf life was non permissible and a significant difference ($p<0.05$) between weeks of 3 and 4 of shelf life was not observed but between other weeks was observed (Table 3).

The permissible count of mold and yeast in Iranian standard institute is 10^2 CFU/gm and the samples in first week showed abnormal range. For this group of microorganisms, only between weeks 3 and 4 a significant difference was observed ($p<0.05$) (Table 4).

In present study, no coliforms were isolated from the collected samples during the 5 weeks and this agrees with the Iranian standard institute acceptability (Table 5).

Table 1: Mean, standard deviation and standard error mean of hot smoked sausage total bacterial count

Onw-Sample Statistics				
	N	Mean	Std.Deviation	Std. Error Mean
tbc 1	6	5333.333	1366.26010	557.7734
tbc 2	6	6333.333	1366.26010	557.7734
tbc 3	6	8500.000	4086.56335	1668.333
tbc 4	6	99500.000	136899.598	55889.03
tbc 5	6	227000.0	283131.065	115587.8

Table 2: Mean, standard Deviation and standard error mean of hot smoked sausage coagulase positive *Staphylococcus aureus* count

Onw-Sample Statistics				
	N	Mean	Std.Deviation	Std. Error Mean
st1	6	150.0000	137.84049	56.27314
st2	6	200.0000	89.44272	36.51484
st3	6	316.6667	98.31921	40.13865
st4	6	1516.667	1718.62384	701.6251
st5	6	9916.667	1246.32991	5087.725

Table 3: Mean, standard Deviation and standard mean of Hot smoked sausage total psychrophilic microorganism count

Onw-Sample Statistics				
	N	Mean	Std.Deviation	Std. Error Mean
Ps1	6	4000.000	2756.80975	1125.463
Ps2	6	7666.667	3669.69572	1498.147
Ps3	6	10500.00	1516.57509	619.1392
Ps4	6	231166.7	183181.240	74783.43
Ps5	6	263500.0	21.650.184	85997.58

Table 4: Mean, standard Deviation and standard mean of hot smoked total sausage mold and yeast counts

Onw-Sample Statistics				
	N	Mean	Std.Deviation	Std. Error Mean
fu1	6	1650.000	1716.68285	700.8328
fu2	6	3633.333	4124.88384	1683.977
fu3	6	2233.333	1222.56561	499.1103
fu4	6	2650.000	1054.03985	430.3100
fu5	6	41666.67	40227.68533	16422.88

Table 5: Microbial properties of hot smoked sausage during shelf life (Log CFU/gm)

Week	TBC	Sta.	E-coli	Psy.	Y&M
1	3.7	2.17	0	3.6	3.2
2	3.8	2.3	0	3.8	3.2
3	3.9	2.49	0	4.02	3.3
4	4.9	2.69	0	5.3	4.2
5	5.3	3.99	0	5.4	4.6

DISCUSSION

Microbial contamination may be added or reduced at different stages of processing of hot smoked sausage and Friedhoff *et al*. [13] have described the use of simple microbiological criteria, including aerobic mesophilic colony counts, Enterobacteriaceae counts and in some instances, enumeration of yeast, performed on samples taken during processing in small businesses to verify good manufacturing practices. This verification through monitoring was found to be an attractive alternative to the examination of end products and also coliform bacteria are one of most important indicator organisms that are most commonly used to ensure food safety [14-16]. In present study, coliform bacteria were not isolated.Dowdell and Board [17] carried out a microbiological survey of British Fresh Sausage and reported the presence of coliform bacteria. Also in one study by Sachindra *et al*. [18] who isolated coliforms from raw and cooked sausage and in cooked form of sausage less than raw sausage These results demonstrate that cooking process cases reduce the microbial counts substantially in the sausage.Sachindra *et al*. [18] reported the absence of *Staphylococcus aureus* from raw and cooked sausage which with the present study because at first week *Staphylococcus aureus* was isolated from hot smoked sausage samples. In a study made by Apaidin *et al.* [19] on chemical quality of vacuum-packaged hot smoked sausage, *Staphylococcus aureus* was isolated from the studied samples. These results show the importance of *Staphylococcus aureus* in food industry because this agent causes dangerous diseases in human.

Vacuum packaging is generally used for cooked products and these products have scarcely high yeast and mold counts [20, 21]. High yeast and mold counts may have originated from insufficient vacuum and/or refracted vacuum. In this study, yeast and mold counts ranged from $1.6\pm1.4\times10^3$ CFU/gm in first week to $4.1\pm3.2\times10^4$ CFU/gm in fifth week These results agree with one study by Apaidin *et al*. [19], but this range in comparison with a study by Sachindra *et al*. [18] is high.

Psychrophilic organisms` counts in first week of shelf life was non permissible and aA significant different ($p<0.05$) between all weeks of shelf life were not observed but in the study of Sachindra *et al*. [18] these microorganisms show a low growth during time of the study [18].

In a study on vacuum packed cooked ring sausage during storage, a shelf life of 20-28 days [22] and 43 days [23] has been found. A shelf life of 49 days in Hot smoked sausage packed in CO_2 was recorded [24]. Some studies showed that the augment of the additives, onion, garlic meal, pepper and E vitamin can decrease the microbial agents in cooked sausage products [25-28].

In conclusion, the study revealed the pattern of microbial profile associated with the preparation of Hot Smoked Sausage. Lower initial microbial levels of sausage mix, effective heat treatment during cooking, careful handling of cooked sausage and maintenance of adequate chill temperature during storage would improve the microbiological quality and enhance the shelf life of hot smoked sausage.

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