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HEALTHY SAFE, QUALITY CRITERIA, AND SENSORY ACCEPTABILITY OF TRADITIONAL AND FERMENTED TALANG QUEENFISH SAUSAGE TRIALS AS AFFECTED BY PROCESSING TREATMENTS.

BY

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ABSTRACT

This research was performed to investigate the ability of using Talang queenfish meat in the manufacturing of inexpensive traditional and fermented fish sausage trials, which having a high nutritional quality, a better acceptability for consumer and good healthy safe quality for a relatively long shelf-life under proper storage condition, as a substitute of red meat sausage products. This study includes the proximate chemical analysis and the evaluation of chemical properties (The TVB-N, TMA-N, VRS, tyrosine and the TBA values), healthy safe quality criteria with regards the microbiological quality and heavy metals level, and sensory quality criteria for produced traditional and fermented Talang queenfish sausage trials as affected by different processing treatments, including microwave grilling, roasting, frying and smoking process.

The obtained results illustrated that tested processing treatments caused a reduction in the TVB-N, TMA-N and the VRS values, while they led to increase tyrosine and the TBA values in fish sausage trials, with the exception of smoking process which caused a remarkable decrease in the latter criterion value. Processing treatments also caused a highly decrease in the total bacterial and mold & yeast counts of all fish sausage trials in which the psychrophilic bacteria was not detected. In addition, potassium sorbate treatment inhibited the microbial growth and activity, the oil oxidation and protein breakdown in fish sausage trials.

In general, the produced Talang queenfish sausage products had a good chemical quality properties and healthy safe quality criteria with regards the microbiological aspects and heavy metals level, which were within the permissible limits reported in the standard specifications and legislations for fishery products, as well as they characterized with a good acceptability and sensory quality. Therefore, it should be directed towards the utilization of chosen fish meat in manufacturing of inexpensive fish product having a much better healthy safe quality and acceptability, as a substitute of red meats sausage.

Key words: Talang Queenfish - Heavy Metals - Proximate Analysis - Healthy Safe - Quality Criteria - Sensory Acceptability-Processing Treatments -Fermented fish Sausage.

INTRODUCTION

It is well known that the countries of the third world including Egypt are actually facing a critical situation which is the shortage of available good quality animal protein, especially with the continuous over population in these countries, consequently the development of fisheries and the attention towards the utilization of fish and fishery products have been proposed as a possible solution of this problem (Arslan and Dincoglu, 2001, Kose *et al.*, 2001 and Lyhs, 2002)

Queenfish is belonging to Carangidae family which broadly distributed throughout the tropical and subtropical Indian Ocean and in the western and central Pacific Ocean. Major catches are obtained in India at depths of 15 to 18 m in water surrounding off shore Islands . Talang queenfish (*Scomberoides commersonnianus*) is the most common and the largest marine fish species of Carangidae family which grows to a maximum size of about 120 cm-long and about 16 kg-weight . In addition, Talang queenfish species are characterized with a highly efficiency of their growth and reproduction, resistance to handling and diseases, efficient conversion of low-protein diets and their dependence on the nature feeding (Froese and Pauly, 2005) . Therefore, Talang queenfish species are considered a good source of protein and another nutrients, such as some vitamins, trace elements and omega-3-fatty acids, for humans in many developed and undeveloped countries all over the world . Although the Talang queenfish species are produced, nowadays, in a large quantities as a highly available inexpensive protein source in Egypt, they are not utilized for human nutrition yet as they are neither well-known nor popular for the Egyptian consumer .

Beef sausage are considered one of the most popular food items which are played a significant role in the modern diets, as a core member of the fast food family prepared in restaurants and at home . In these products, the carcinogenic nitrosamines and nitrosmyoglobin were formed at a much higher levels in the presence of nitrous and nitric acid salts, that has been reported to be one of the major illnesses among food borne diseases. So, it must be investigate the utilization of the abundance in the local cheap Talang queenfish meat in the manufacture of both traditional and fermented fish sausage trials which having high nutritional quality, a better acceptability for consumer and good healthy safe quality for a relatively long shelf life under proper storage conditions, as a substitute of red meats sausage products, this would be a great consideration has a high economic value and healthy benefits .

The food industry therefore has to continually develop new product and get them to the consumer as quickly as possible to beat competition with the analogous food products strongly in either the domestic or international markets At the same time, the new food have being manufactured at the least cost and have being safe for the consumer's health as well as having a good quality assurance criteria, in conformity with international standard specifications and legislations of food (ACPSFPI, 2000 and Kramer, 2000) Recently, consumers have placed the increasing emphasis on food safety and high efforts have been focused regarding to bacterial and chemical sources of hazards in canned fishery Products (Jericho *et al.*, 2000) .

Microbiological activity and biochemical changes during processing and storage of fish and fishery products are mainly responsible for progressive decline of organoleptic quality, specifically, the enzymatic breakdown products in fish tissue reflects the initial phases of autolytic deterioration, as well as the bacterial spoilage (Woyewoda *et al.*, 1986) .

Environmental pollution represents a major problem in both developed and undeveloped countries . Egypt is one country which suffers from high biosphere pollution (air, soil and water) . Many ecological changes occur in water as a result of human activities, including agricultural, industrial and municipal wastes . Cd, Cu, Pb and Zn salts are usually found in agricultural and industrial liquid wastes (McCrea and Fischer, 1986 and El-Gamal, 1993) Which are discharged into water recourses . These metals are toxic and may be accumulated from water to higher levels in fish tissues (Wageman, 1989). The excess of heavy metals intake, especially Hg and Pb, causes many harmful and neurotoxic effects to human health (Marzec and Bulinski, 1996 and Rowayshed *et al.*, 2002).

Therefore, it is a great contribution in food technology and human nutrition to try to produce the diverse fish sausage products having a good healthy safe quality for a long time with improving the other quality criteria at the least cost in accordance with both the consumer's demands and legislat ons of food, as a substitute of red meat sausage products . However, little efforts have been made, as well as a few reports have been published in this concern . Our research is performed to try to produce the diverse traditional and fermented Talang queenfish sausage trials and to assess the quality properties, sensory acceptability and the safety, with regards to the microbial quality and heavy metals levels, of produced fish sausage trials .

MATERIALS AND METHODS

Materials:

Fresh fish obtained from local markets, Al-Obour city, Cairo Governorate. Samples were washed carefully with tap water then packed in ice boxes and transported to Fish Processing and Technology Laboratory, Fish Research Station, Kanater El-Khiria National Institute of Oceanography and Fisheries, belonging to Ministry of higher education and Scientific Research within two hours. Upon arrival, the queenfish samples (were ranging between 4.5 to 6.0 kg) were re-washed, beheaded, eviscerated, skinned, filleted and minced.

Lactic acid bacteria (*Lactobacillus lactis*) strain was obtained from Cairo Mircen belonging to Fac. Agric., Ain Shams University Shoubra El-Kheima and the starter culture were enrichment in whey milk media.

Natural casings and spices mixture ingredients including Coriander, cubeb, cumin, black pepper, red pepper, cardamom, cloves were obtained from local market, Cairo Governorate.

Methods:

Processing of fish sausage trials :

Two groups of Talang queenfish sausage were processed: The first group was the traditional fish sausage with and without potassium sorbate. The second group was fermented fish sausage with and without potassium sorbate. The commercial style dressing as described by Francisco, *et al.* (1972) was as followes:

Each fresh fish was dressed carefully by removing scales, fins, head, tail and viscera. The body cavity was washed with tap water to remove any traces of viscera and blood, after that, the skin was removed and the flesh was cut into desired consistent size fillets which trimmed. Fish fillets were minced after traces of blood on flesh fillets were cleaned with tap water. After being strained, fish flesh were mixed by recipe presented in Table (1) as described by (Chandrasckhar and Mohite, 1978) with some modification of sugar and starch content in fermented fish sausage. For production of fermented fish sausage appropriate amounts of (*Lactobacillus lactis*) mixed broth was inoculated to a final level of 10^7-10^8cfu/g of minced fish flesh and mixed well with the other components of recipe. The resulting ground fish sausage with and without potassium sorbate were fermented at 37°C for 24 h. Whereas, traditional and fermented sausage trials ingredients were stuffed into natural casings.

Technological treatments:

Fried sausage were prepared by frying raw sausage samples in corn oil at 160 ± 5°C for 6 minutes using traditional pan frying according to Abou-Taleb (1993).Roasted sausage was prepared by roasting the raw sausage samples for 20 minutes at 170 ± 5°C using an electric oven according to Fey and Regenstein (1982). Microwave grilled sausage was prepared using microwave oven at 980 watt for 5 minutes (2.5 min. for each side). Smoked sausage was prepared by smoking raw sausage samples for 3 hours at 60 ± 2°C using hard wood sawdust as a source of smoke according to Bhuiyan, *et al.*, (1986). All samples were packed in polyethylene bags in which each bag contained 500g of sample.

Table (1): Ingredients and recipes of spice mixture used in queenfish sausage trials:

Ingredients	%	Spices mixture 1.50%	
Fish meat	70.00	**Components**	**%**
Vegetable Oil	5.00	**Coriander**	22.50
Starch	8.00	**Cubeb**	7.50
Sugar	0.61	**Cumin**	15.00
Salt	2.50	**Black pepper**	32.00
Fresh Onions Paste	2.00	**Red pepper**	9.00
Polyphosphate	0.17	**Cardamom**	10.00
Iced water	10.20	**Cloves**	4.00
Ascorbic acid	0.02		
Spices mixture	1.50		

Potassium sorbate was incorpourated to the fish sausage trials containing it at level of 0.20 % at expense of the same level of the iced water.

Analytical methods:

Moisture, crude protein, lipids and ash contents were determined according to A.O.A.C. (1995) methods. Calorific value was calculated according to Davidson, *et al.* (1979).

Trimethylamin nitrogen (TMA-N) of traditional and fermented fish sausage were analyzed according to A.O.A.C. (1995) methods. Total volatile basic nitrogen (TVB-N) and Thiobarbituric acid (TBA) were determined according to Pearson (1976).Volatile reducing substances VRS was determined according to Mooshouse and Salwin (1969). Tyrosine value was determined according to Pearson (1968).

Total bacterial count (TBC) and psychrophilic bacteria were determined according to Oxide (1979). Whereas, yeasts and moulds counts were enumerated on malt agar as mentioned by APHA (1976).

The Atomic Absorption Spectrophotometer (Model Perkin-Elmer 3010) was used to determine the heavy metals (Fe, Zn, Mn, Pb, Cd, Hg, Cu and Ni) content for fish sausage samples according to the method described by Goldberg, et al. (1963).

Organoleptic evaluation: Fermented and non-fermented Talang queenfish sausage samples were tested for flavor, color, texture and overall acceptability by ten-member semi-trained taste panel. Judges scored for all parameter on a 9-points hedonic scale, with higher values denoting better quality according to the procedure of Fey and Regenstein(1982). The data were exposed to proper statistical analysis according to Snedecor and Cochran(969).L.S.D. at 5% level of significance was used to compare between the means.

RESULTS AND DISCUSSION

Chemical composition of fish sausage trials:

The chemical composition of traditional and fermented fish sausage trials with and without potassium sorbate are tabulated in Table (2) on dry weight basis.

The moisture content of different types of raw fish sausage samples ranged from 61.52 to 61.98%, and it was decreased after processing treatments (microwave grilling, roasting, frying and smoking). This decrease was attributed to the evaporation of water from the surface of different fish sausage samples (Abou-Taleb, 1993).

The protein content percentage of raw traditional and fermented fish sausage trials without and with potassium sorbate was 42.04, 42.24, 43.87 and 43.53, on dry weight; respectively. After cooking methods, the protein content was decreased; such decrease was more pronounced in fish sausage processed by frying followed by smoking and roasting processes. Generally, the obtained results of protein content were indicated that the processing treatments (frying, roasting, smoking and microwaving) caused a significant loss in protein content of fish sausage samples.

Table (2): Proximate composition (%) of traditional (T) and fermented (F) fish sausage samples without and with potassium sorbate

Parameter	Moisture content		Protein		Fat		Ash		*Carbohydrates		**Calorific value	
Samples	T	F	T	F	T	F	T	F	T	F	T	F
A-Without Potassium Sorbate												
Raw	61.66	61.52	42.04	43.87	22.91	22.46	10.55	10.55	24.50	23.12	472.35	470.10
Microwave	56.16	56.02	38.47	40.30	23.89	23.02	11.50	11.50	26.14	25.18	473.45	469.10
Roasted	51.61	51.47	37.83	39.66	20.95	21.49	14.46	14.45	26.76	24.40	446.91	449.65
Fried	45.75	45.61	34.04	35.77	28.97	29.47	12.56	12.56	24.43	22.20	494.61	497.11
Smoked	54.16	54.02	37.65	39.48	24.36	25.91	10.87	10.93	27.12	23.68	478.32	485.83
B-With Potassium Sorbate												
Raw	61.63	61.98	42.24	43.53	22.72	22.29	10.48	10.54	24.56	23.64	471.68	469.29
Microwave	56.13	56.48	38.67	39.96	24.28	24.93	11.43	11.49	25.62	23.78	475.68	479.34
Roasted	51.57	51.93	38.03	39.32	20.79	21.21	14.39	14.39	26.79	25.08	446.39	448.49
Fried	45.72	46.07	34.14	35.23	29.89	28.22	12.49	12.55	23.48	24.00	499.49	490.90
Smoked	54.12	54.48	37.85	39.14	25.17	24.69	10.83	10.85	26.15	25.32	482.53	480.05

* Carbohydrates were calculated by difference ** Calorific value calculated as kcal/100g.

Lipid content percentage of both raw traditional and fermented fish sausage without and with potassium sorbate were 22.91, 22.72, 22.46 and 22.29, on dry weight basis, respectively. The lipids content of fish sausage samples increased after microwave griling and smoking methods On the other hand, the roasting method caused a slight decrease of fat content in all fish sausage samples. While, the frying treatment caused a significant increase in the fat content of fried fish sausage, and this may be attributed to the oil absorption during this process.

Ash content percentage of both raw traditional and fermented fish sausage trials without and with potassium sorbate was: 10.55, 10.48, 10.55 and 10.54, on dry weight basis; respectively. The higher ash content showed in roasted fish sausage (14.39 - 14.46 on dry weight) followed by fried (12.49 – 12.56), microwave grilled (11.43 – 11.50), smoked (10.83 - 10.93). The raw sample was lower in ash content as shown in Table (2).

Carbohydrates percentage were calculated by difference and it were (24.5 – 24.56) in raw traditional and (23.64 – 23.12) in the fermented fish sausage trials without and with potassium sorbate. A slight increase was observed in the carbohydrates content of all samples as the result of cooking methods, except the frying methods which caused a slight decrease.

The calorific values of both raw traditional and fermented fish sausage trials containing potassium sorbate or not were: 472.35, 471.68, 470.10 and 469.29 Kcal/100g on dry weight basis, respectively. From the obtained results, it could be noticed that the microwave cooking and smoking had no remarkable effect on the calorific values of fish sausage samples. But, the roasting method caused a decrease in the calorific value of fish sausage samples. This decrease might be due to the fat loss of fish sausage samples during roasting process. On the other hand, the frying process caused a remarkable increase in the calorific value, this incremental rate may be due to the high fat content of fish sausage samples after frying treatment. These results are in a good agreement with the values reported by Bigureas *et al.*, 1985; Dessouki *et al.*, 1986; Bhuiyan *et al.*, 1986; Nassar, 2002 and Gomma 2005.

Chemical quality criteria of fish sausage trials:

As shown in Table (3) the chemical quality criteria of both traditional and fermented fish sausage trials contaning potassium sorbate or not were affected by different technological treatments such as frying, roasting, smoking and microwave grilling processes. The initial TVB-N of raw samples were 42.46, 41.07, 40.14 and 41.75 mg/100 g dry weight basis, respectively .After the processing treatments, it was observed that there was a loss in the TVB-N content occurred in traditional and fermented fish sausage trials, especially in those containing potassium sorbate, whereas the highest loss was observed with microwave grilling process followed by frying, roasting and smoking process. This obtained results go in parallel with the findings of Dessouki, *et al.* (1986) and, El-Deep, (1987) who found that the TVB-N content of sausage samples was reduced after technological treatments by cooking and smoking.

Table (3): Chemical quality criteria of traditional (T) and fermented (F) fish sausage trials as affected by technological treatments.

Parameter	TVB-N (mg/100g)		TMA (mg/100g)		VRS micro-equevillent-KmnO4 reduced/g		Tyrosine (mg/100g)		TBA mg Malona/dhyde/kg	
Samples	T	F	T	F	T	F	T	F	T	F
A-Without Potassium Sorbate										
Raw	42.46	40.14	1.59	1.55	7.25	12.85	53.48	52.66	1.75	2.33
Microwave	31.74	34.53	1.51	1.47	6.53	11.28	89.39	88.59	2.71	2.65
Roasted	36.49	37.18	1.42	1.40	6.65	11.36	83.39	85.24	1.85	1.95
Fried	35.41	36.46	1.32	1.33	5.59	10.28	80.84	79.03	1.72	1.90
Smoked	37.34	38.27	1.53	1.46	7.22	11.42	99.02	98.31	0.06	0.07
B-With Potassium Sorbate										
Raw	41.07	41.75	1.42	1.38	6.90	11.35	49.75	48.79	1.47	1.59
Microwave	32.67	31.78	1.36	1.31	5.76	10.19	85.22	86.41	2.47	2.50
Roasted	35.47	35.59	1.27	1.28	5.86	10.33	81.41	80.82	1.55	1.45
Fried	33.65	34.61	1.07	1.20	4.39	9.91	78.60	77.96	1.40	1.35
Smoked	38.27	38.26	1.38	1.33	6.84	10.87	97.85	85.65	0.05	0.04

TVB-N: Total volatile basic nitrogen.
TMA-N: Trimethylamine nitrogen.
VRS: Volatile reducing substances.
TBA: Thiobarbituric acid.

From the previous results (Table 3), it could be illustrated that the TMA-N value of raw traditional and fermented fish sausage without and with potassium sorbate were 1.59; 1.42; 1.55 and 1.38 mg/100g dry weight basis, respectively. All processed treatments caused a decrease trend in the TMA-N values of all fish sausage samples. The loss of the TMA-N content of fish sausage trials occurred after cooking may be mainly due to the effect of heat treatment on the TMA-N especially microwave grilling treatment. This results are in agreement with those reported by Khallaf (1990), Abou-Taleb (1993) and Gomma (2005).

As for volatile reducing substances (VRS) content in raw samples, they were 7.25, 6.90, 12.85, and 11.35 mic-eq-$kmno_4$ reduced/g dry matter. The obtained results indicated clearly that processing treatments by frying, microwave grilling, roasting and smoking caused a decrease in the VRS content of fish sausage samples, especially with the addition of potassium sorbate. Such decrease was more significant in fish sausage samples processed by frying followed by microwaving, roasting and smoking treatments. Generally, the obtained results showed that the cooking methods and smoking process of fish sausage samples reduced the VRS contents of all tested fish sausage trials, especially with addition of potassium sorbate. This loss may be due to the effect of heat used in the tested processing treatments, which caused a volatilization of the VRSs (Abou-Taleb, 1993)

The tyrosine value of raw traditional and fermented fish sausage without and with potassium sorbate was 53.48; 49.75; 52.66 and 48.79 mg/100g on dry weight basis. From the same data, it could be noticed that all cooking methods and smoking process caused a significant increase in tyrosine value. This increase may be mainly due to the decomposition occurred in proteins of processed fish sausage samples. In addition, potassium sorbate treatment reduced the increasing rate of the tyrosine content in fish sausage trials.

With regards the alteration in thiobarbituric acid (TBA) of fish sausage, as affected by cooking methods as shown in Table (3), the initial TBA values of raw samples were 1.75, 1.47, 2.33 and1.59 mg malonaldhyde per kg dry samples. Also, it was noticed that there was an increase in the TBA values occurred after cooking treatments, especially with the microwave grilling process. This results are in accordance with results obtained by Abou-Taleb (1993) and Gomma (2005). Also, it could be noticed that the smoking process caused a remarkable decrease in TBA value of all treatments of fish sausage. This decrease might be due to the antioxidative action of smoke phenols. On the other hand, potassium sorbate treatment inhibited the oil oxidation in fish sausage trials as a result of its antioxidant properties (Abou-Taleb, 1993). Generally, the tested processing treatments caused a noticeable loss in the TVB-N, TMA-N and VRS contents, while they increased the tyrosine and the TBA values of both traditional and fermented fish sausage trials, with the exception of smoking process which caused a remarkable reduction in the latter creterion value. The values of the former quality criteria of all prepared fish sausage trials were much lower than their critical hazard limits reported by Egyptian Standard Specifications, (1993),

regardless of the alteration in these quality criteria. In addition, potassium sorbate treatment inhibited protein decomposition and oil oxidation in fish sausage trials.

Healthy safe quality criteria of fish sausage trials:

The total bacterial counts (TBA) of both traditional and fermented fish sausage contained potassium sorbate as affected by processing treatments are presented in Table (4). The TBC of raw, microwave grilled, roasted, fried and smoked traditional fish sausage trials containing potassium sorbate or not were (0.68-0.59), (0.54-0.51), (0.55-0.47), (0.39-0.28) and (0.53-0.49) $x10^4$/g, respectively. While the TBC of the corresponding fermented fish sausage trials were (0.75-0.70), (0.64-0.62), (0.63-0.52), (0.42-0.30) and (0.66-0.63), respectively. Therefore, the addition of potassium sorbate inhibited the microbial growth and activity, as well as a result of thermal destruction of microorganisms, when compared with raw sausage (control) leading to maintain the original high quality criteria and the shelf-life of the final fishery products. Such decrease in TBC was more pronounced in fried fish sausage samples compared to the other processing treatments. These results are in a good agreement with those reported by Abou-Taleb, (1993) and Gomma (2005).

Table (4): Microbiological aspects(cell $x10^4$) of both traditional and fermented fish sausage as affected by processing treatments:

Parameters / Samples	TBC[a]		Psychrophilic		Yeast & molds	
	US[b]	S[c]	US	S	US	S
A- traditional fish sausage						
Raw	0.68	0.59	nd	nd	0.04	nd
Microwave	0.54	0.51	nd	nd	0.03	nd
Roasted	0.55	0.47	nd	nd	0.02	nd
Fried	0.39	0.28	nd	nd	0.01	nd
Smoked	0.53	0.49	nd	nd	0.02	nd
B- Fermented fish sausage						
Raw	0.75	0.70	nd	nd	0.06	nd
Microwave	0.64	0.62	nd	nd	0.05	nd
Roasted	0.63	0.52	nd	nd	0.03	nd
Fried	0.42	0.30	nd	nd	0.02	nd
Smoked	0.66	0.63	nd	nd	0.03	nd

[a] TBC : Total bacterial count. [b] US:Samples Untreated by Potassium Sorbate.
[c] S:Samples Treated by Potassium Sorbate. nd: not detected

The psychrophilic bacterial count was not detected in all tested fish sausage trials. Also yeasts and molds was not detected in samples treated with potassium sorbate. But the raw, microwave grilled, roasted, fried and smoked of traditional fish sausage without potassium sorbate recorded 0.04, 0.03, 0.02, 0.01 and 0.02 x 10^4/g, respectively for yeasts and molds count, versus, 0.06; 0.05; 0.03; 0.02 and 0.03 x 10^4/g, respectively for the corresponding samples of fermented fish sausage without potassium sorbate.

The obtained results also showed that the presence of potassium sorbate inhibited the initial load of psychrophilic bacteria compared with unsorbated samples, and it might be due to the inhibiting effect of sorbate on the growth of *P. fluoresens* and *P. pseudomonas* in the refrigerated foods. This results are in agreement with those reported by (Ali, 1998). It is worth to note that traditional and fermented Talang queenfish sausage, under investigation had a microbiological quality aspects agree with Egyptian Standard Specifications. (1991).

Heavy metals concentrations of the tested fish sausage trials:

It is well known that heavy metals are interfere with cellular biochemistry, mainly be disruption of a variety of enzyme system. Tough disruption of specific enzymes, metal can alter the normal patterns of growth reproductive function, immune function and general metabolism Secondarily, toxic metals interfere with the normal metabolism and functions of required metals (i.e. Ca and Mg). In extreme conditions, some metals are known to be carcinogenic, mutagenic or teratogenic (Friberg, *et al.*, 1986). Therefore, the determination of heavy metals residues in fishery products would be a good contribution for food safety and hygienic quality assurance in human nutrition. So, the residues of these contaminants (Cd, Hg, Cu, Fe, Mn, Ni, Pb, and Zn) were estimated in both traditional and fermented fish sausage with addition of potassium sorbate, under investigation. The obtained results are recorded in Table (5).

From the obtained results, it could be observed that tested processed treatments exhibited different effects on heavy metals concentration in Talang queenfish sausage trials depending upon processing treatment and the heavy metal itself. On the other hand, the predominant heavy metals in all fish sausage trials were found to be Zn, Fe, and Mn at level of 7.15-9.53, 2.80-3.51 and 1.94-2.69 ppm, on wet weight basis, respectively.

The former results, also illustrated that Pb was not detected in all traditional and fermented fish sausage trials. In addition, all fish sausage trials contained the all determined heavy metals within their permissible levels (PLs), as recommended by IPSC/WHO, (1987); FAO/WHO, (1989) and Egyptian Standard Specifications, (1993) with the exception of Cd which was exceed slightly than its PL. Thereupon, the prepared traditional and fermented fish sausage trials were characterized with a good healthy safe quality with regards their contents from heavy metals.

Organoleptic evaluation of the tested fish sausage trials:

Mean values of flavor of fish sausage samples as affected by different processing treatments are given in Table (6). The flavor scores of microwave grilled, roasted, fried and smoked traditional fish sausage samples without and with potassium sorbate were (7.9 and 8.3), (8.6 and 8.9), (8.8 and 9.2) and (9.1 and 8.9), respectively. While, the flavor scores of microwave grilled, roasted, fried and smoked fermented fish sausage samples were (7.6 and 7.8), (8.3 and 8.5), (8.2 and 8.9) and (8.6 and 8.6), respectively.

Table (5): Heavy metals concentration (u/g dry wt.) in both traditional and fermented fish sausage as affected by processing treatments.

Samples	Traditional Fish Sausage				
Heavy metals	Raw	Microwave	Roasted	Fried	Smoked
Cd	1.05	1.35	1.10	1.62	1.17
Hg	0.76	0.59	0.58	0.59	0.63
CU	3.30	3.25	3.15	3.05	2.95
Fe	7.30	7.15	5.80	5.91	6040
Mn	5.25	5.20	4.27	4.95	5.05
Ni	2.40	2.35	2.12	2.20	2.25
Pb	Nd	Nd	Nd	Nd	Nd
Zn	19.70	18.55	16.65	17.55	8.69
	Fermented Fish Sausage				
Cd	1.40	1.37	1..15	1.22	1.35
Hg	0.76	0.60	0.58	0.57	0.64
CU	3.85	3.70	3.20	3.25	3.50
Fe	8.20	8.06	6.30	6.65	6.95
Mn	5.09	4.90	4.25	4.01	4.60
Ni	2.65	2.54	1.95	2.15	2.30
Pb	Nd	Nd	Nd	Nd	Nd
Zn	18.80	17.20	16.25	15.54	17.15

ND: Not detected

The color scores of microwave grilled, roasted, fried and smoked traditional fish sausage samples were (7.6 and 7.8), (8.0 and 8.4), (8.5 and 8.7) and (7.9 and 8.3), respectively. While, the corresponding fermented fish sausage samples were (7.5 and 7.9), (7.9 and 8.3), (8.5 and 8.9) and (7.8 and 8.1), respectively.

With regards to judging texture scores as shown in Table (6), the mean scores of this characteristic for the treated samples of sausage containing potassium sorbate were higher than that without potassium sorbate.

Mean values of overall acceptability of traditional fish sausage samples as affected by different processing treatments are given in Table (6). The initial scores of overall acceptability of microwave grilled, roasted, fried and smoked traditional fish sausage samples without and with potassium sorbate were (7.9 and 8.0), (8.3 and 8.8), (8.8 and 9.1) and (8.5 and 8.7), respectively. While, the initial scores of overall acceptability of microwave grilled, roasted, fried and smoked fermented fish sausage samples without and with potassium sorbate were (7.7 and 7.4), (8.2 and 8.5), (8.6 and 8.9) and (8.2 and 8.4), respectively.

It could be observed that the fried fish sausage trials had the best color, flavor, texture and overall acceptability compared with those treated with different processing treatments followed by roasting, smoking and microwaving process. Also, it could be observed that the traditional fish sausage samples had the best sensory scores compared with fermented fish sausage type, and this may be attributed to the food habitats that differed between consumers.

Table (6): Sensory evaluation for fish sausage trials as affected by different processing treatments.

Parameters / Samples	Flavor		Color		Texture		Overall acceptability	
	*US	**S	*US	**S	*US	**S	*US	**S
A-Traditional fish sausage								
Microwaved	7.9	8.3	7.6	7.8	8.1	8.3	7.9	8.0
Roasted	8.6	8.9	8.0	8.4	8.7	9.0	8.3	8.8
Fried	8.8	9.2	8.5	8.7	9.1	9.3	8.8	9.1
Smoked	9.1	8.9	7.9	8.3	8.4	8.8	8.5	8.7
L.S.D.at 5 %	0.2	0.3	0.3	0.3	0.3	0.4	0.3	0.3
B- Fermented fish sausage								
Microwaved	7.6	7.8	7.5	7.9	8.1	7.9	7.7	7.4
Roasted	8.3	8.5	7.9	8.3	8.4	8.8	8.2	8.5
Fried	8.2	8.9	8.5	8.9	9.1	9.1	8.6	8.9
Smoked	8.6	8.6	7.8	8.1	8.2	8.5	8.2	8.4
L.S.D.at 5 %	0.2	0.28	0.25	0.26	0.24	0.22	0.23	0.18

* US: Samples untreated by potassium sorbate

** S:Samples treated by potassium sorbate

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صفات الأمان الصحي والجودة والقبول الحسي لسجق أسماك الجمل العادي والمختمر ومدى تأثرها بالمعاملات التصنيعية .

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لقد استهدفت هذه الدراسة إحلال لحم أسماك الجمل بدلا من اللحوم الحمراء فى تصنيع منتجات السجق السمكي الرخيصة الثمن والعالية في جودتها الغذائية والآمنة لصحة المستهلك كبديل لمنتجات السجق المصنع من اللحم البقرى أو الجاموسي .

ولقد تضمنت هذه الدراسة تقييم صفات الجودة الكيميائية ودرجة الأمان الصحية (الجودة الميكروبيولوجية ومحتواها من المعادن الثقيلة) ودلائل الجودة الحسية لمنتجات السجق السمكي العادي والمختمر المصنعة من لحم أسماك الجمل المختارة ومدى تأثرها بإضافة سوربات البوتاسيوم والمعاملات التصنيعية المستخدمة (القلي في الزيت، الشي في الفرن الكهربائي، الشي في فرن الميكروويف، التدخين). ولقد أوضحت النتائج المتحصل عليها أن المعاملات التصنيعية المستخدمة قد أدت إلى حدوث انخفاض واضح في قيم القواعد النيتروجينية المتطايرة ومركب الثلاثي مثيل أمين - نيتروجين والمواد المتطايرة المختزلة الكلية وعلى النقيض قد أدت تلك المعاملات إلى حدوث زيادة واضحة في قيم التيروسين وحامض الثيوباربتيوريك في منتجات السجق السمكي باستثناء المعاملة بالتدخين التي أدت إلى حدوث انخفاض واضح في قيمة دليل الجودة الأخير . كما لوحظ أن المعاملات التصنيعية المستخدمة قد سببت نقص شديد في العدد الكلى للبكتريا والخمائر والفطريات هذا بالإضافة إلى عدم ظهور البكتريا المحبة للبرودة في جميع منتجات السجق السمكي المصنعة . ولقد أدت المعاملة بإضافة سوربات البوتاسيوم إلى تثبيط النمو الميكروبي وأكسدة الدهن وتكسير البروتينات في تلك المنتجات . وبصفة عامة فإن منتجات السجق السمكي المصنعة قد تميزت بجودة كيميائية ودرجة أمان صحية جيدة تتفق مع الحدود الآمنة المسموح بها والتي أقرتها المواصفات القياسية والتشريعات الغذائية لمنتجات الأسماك هذا بالإضافة إلى تميزها بدرجة قبول عالية وجودة حسية ممتازة . لذا فإنه يجب الاتجاه نحو استخدام لحوم الأسماك المختارة في إنتاج منتجات السجق السمكي الرخيصة الثمن والتي تتميز بجودة أمان صحية ودرجة قبول جيدة كبديل لمنتجات السجق المصنعة من اللحوم الحمراء.