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FISH SAUSAGE – ITS PREPARATION AND QUALITY CHANGES DURING STORAGE

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RINGKASAN

Sosej ikan telah dihasilkan dari ikan tuna (aya atau tongkol) (*Euthynnus affinis* Cantor). Komposisi kimia hasilan tersebut adalah seperti berikut – 63.7% kelembapan, 13.7% protein (N x 6.25), 5.2% lemak dan 1.6% abu. Sosej ikan telah ditinkan di dalam 2% air garam dan didapati masih boleh diterima setelah disimpan selama enam bulan pada suhu biasa (30°C). Semasa kajian penyimpanan dijalankan tidak ada apa-apa perubahan pada produk tersebut dikesan samada dari segi kimia, mikro dan juga nilai rasa. Sosej yang dipak vakum disimpan pada suhu dingin dan sejukbeku mempunyai tempoh penyimpanan selama 12 minggu dan enam bulan tiap-tiap satu berdasarkan kajian kimia dan mikro.

INTRODUCTION

Fish has been extensively used in the making of fish sausages and as meat extenders in products such as frankfurters and sausages (MCLAY, 1970; HERBERG, 1976; STEINBERG, SPINELLI and MIYAUCHI, 1976). The use of various additives in sausage making has been reported by several research workers (TANIKAWA, SUWAKI and AKIBA, 1960; HALL, HARRISON and MACKINTOSH, 1962; AMANO, 1965; BAUERNFEINDand PINKERT, 1970; WADA, NONAKA, KOIZUMI, KONUMA and SUZUKI, 1976; ZEN–NIPPON, 1976). These include chemical preservatives such as ascorbic acid, polyphosphates, sodium chloride, ascorbates, nitrites, nitrofuryl – acrylamide and flavour enhancers such as monosodium glutamate and sodium 5^{l} – ribonucleotide.

Various recipes have been used (AMANO, 1965; MACLAY, 1970; BARAL, BUDINA and REKHINA, 1975; HERBERG, 1976; ZEN–NIPPON, 1976; REKHNINA, BUDINA, POLYAKOVA and VERKHOTUROVA, 1977). The acceptability and spoilage losses of fish sausages during storage have been studied by AMANO (1965), MCLAY (1970), BUDINA and GROMOV (1976), STEINBERG *et al.*, (1976) and DALEY, DENG and OBILINGER (1979).

In 1974, the author prepared fish sausages from scad (*Decapterus russelli*, Ruppi), chub mackerel (*Rastrelliger kanagurta*, Cuv), sardines (*Sardinella* sp.) and tuna (*Euthynnus affinis*, Cantor) (WAN RAHIMAH, 1974; 1978). The products were found to be highly acceptable organoleptically and microbiologically but no storage study was conducted on the fish sausages developed.

In this study a similar method is used with some modifications made in the product formulation. The developed fish sausages were canned in brine and evaluated for chemical and organoleptic changes within the storage period of six months. Some studies on vacuum packed fish sausages kept under chilled and frozen conditions were also conducted.

MATERIALS AND METHOD

In this study tuna (*Euthynnus affinis*, Cantor) belonging to the family Scombridae which ranges between 30 – 50 cm in length was used. Fish obtained from the market were beheaded and entrails were removed. After a thorough washing, the fish was passed through a deboning machine. The flesh recovery for tuna ranges from 60% to 70%. The flesh which comprises of both red and white meat was used in the preparation of sausages.

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Sausages used in the shelf life study was prepared using the formulation given below following the method outlined in *Figure 1.*

Table 1. Ingredients used for fish sausage

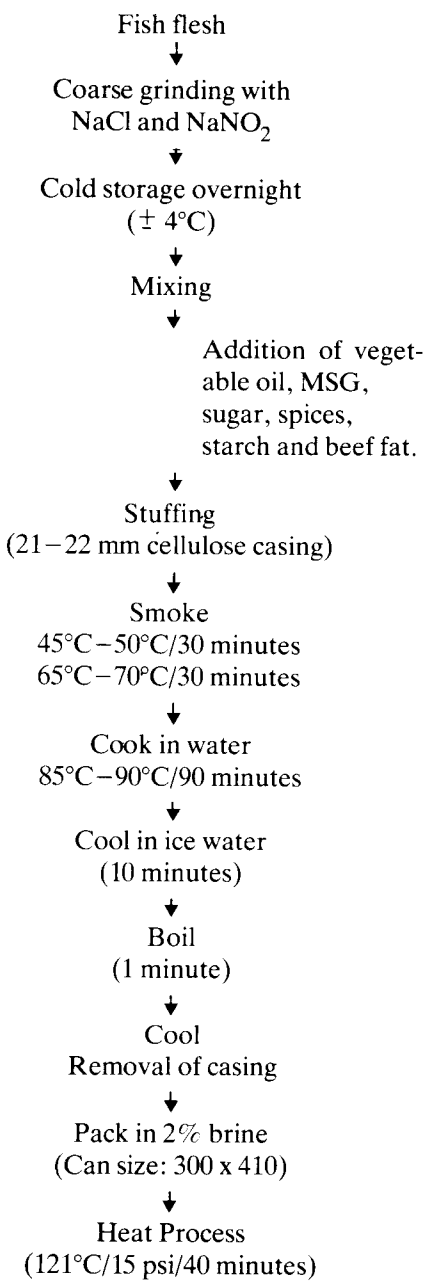
Ingredient	Weight in grammes
Tuna flesh	1500.0
Salt	37.5
Vegetable oil	120.0
Monosodium glutamate	3.0
Sugar	24.0
Pepper	1.0
Garlic	2.6
Onion	25.0
Ginger	1.6
Starch	120.0
Beef fat	150.0
Nitrite	0.15

Canned sausages were stored at ambient temperature and analysed for their chemical and organoleptic properties fortnightly. In another study, freshly prepared fish sausages were vacuum packed in 0.14 mm polypropylene and polyester/polyethylene laminate and stored under chilled and frozen conditions respectively. Chemical and microbiological analyses were carried out on the stored samples.

RESULTS AND DISCUSSION

The various steps used in the preparation have a great influence on the elasticity of the product. During the grinding process salt plays a very important role in the extraction of salt soluble protein, mainly myosin which forms the network by cross linking adjacent polypeptide chains resulting in elasticity to the product. Salt concentration of 2.5% was used and found to be effective in achieving the maximum extraction of myosin as well as to contribute to flavour.

Figure 1. Flowchart for the preparation of canned fish sausage



Grinding was carried out by the use of stone mortar which has three pestles which rotate while pressing the inside of the mortar. By the kneading and crushing action of the pestles the texture of the muscle gradually attains a sticky nature. A bowl

chopper which has several revolving knives on a shaft can also be used. The knives revolve at high speed chopping and mixing the meat simultaneously.

After the addition of ingredients the ground fish paste was shaped as soon as possible because fish paste often sets if stored and thus cannot be shaped. Cellulose casings are permeable and allow the exchange of moisture and vapour. Collagen casings which are made from processed extracts of the corium layer of beef cattle hides cannot be used for canned fish sausages because the high cooking (85°C–90°C) and retorting temperatues (121°C) will result in excessive breakage of the sausages.

Cooking greatly influences the formation of network necessary in sausage making. In order to obtain good gel strength and keeping quality, a cooking temperature exceeding 75°C is necessary (OKADA, 1967). In this study a cooking temperature of 85°C–90°C for a period of 90 minutes was used. This was followed by prompt cooling in ice water till the internal temperature reaches about 21°C and immersion in boiling water for a minute.

Previous to the use of 100 ppm nitrite for colour development, trials using artificial colouring materials such as cochineal and ponceaux were made but were found to be unsuccessful in aiding in colour development. When nitrite is used in the preparation of red flesh meat fish, it combines with haemoglobin or myoglobin to form nitrosohaemoglobin or nitrosomyoglobin which are stable and bright red in colour (TANIKAWA, 1969).

a. $HNO_3 \xrightarrow[\text{reduction}]{\text{bacterial action}} 2HNO_2 \rightarrow H_2O + \underline{NO} + NO_2$

b. Hb. + NO $HbNO_2$

Haemoglobin — Nitrosohaemoglobin
Myoglobin — Nitrosomyoglobin

Nitrite was applied in the following manner – 100 ppm $NaNO_2$ and 2.5% NaCl were thoroughly mixed with deboned tuna meat and this mixture was kept in cold storage overnight. It should be stressed here that once the red flesh meat has already been oxidised to methamyoglobin or metmyoglobin (blackish red colour), the effect of nitrite on colour development is lost. In such cases ascorbic acid can be added at 0.05–0.5 g per 1 kg meat to reduce it to the original bright red (TANIKAWA 1963).

Chemical Composition of Fish Sausage

Fish sausage prepared in the laboratory have the following chemical composition.

The method used in the preparation of fish sausages is similar to those used by the above workers but differ in the use of ingredients. The sausages were found to have excellent physical and organoleptic properties.

Quality Changes During Storage

The quality of fish sausages is measured by its elastic property or cohesiveness. They should be well bound with high jelly strength, good moisture content and fat holding capacity. These factors will contribute to a long shelf life of the product. Distinct eating characteristics such as elasticity and flexibility also affect the appearance and glossiness of the fish sausage. The elasticity of fish sausage is dependent on numerous factors i.e. species, freshness, processing techniques and ingredients used. Fish have different gel forming abilities (TANIKAWA, 1969) and the chemical composition of a particular species differ with age, fishing ground, season etc. As such proper selection of raw material is essential for the development of a high quality product as fish meat has a high microbial load when spoilt or mishandled.

The shelf life of fish sausages have been

found to be one month when kept at 30°C (OKADA, 1967; ANON, 1969). DALEY *et al.*, (1979) found that mullet sausages have a shelf life of two weeks when kept at 2°C with no preservative added other than liquid smoke flavour (0.5%) and $NaNO_2$ (100 ppm). Starch has been shown by several investigators (KIMATA and KAWAI, 1951; KIMATA and SOSOGI, 1956) to be the primary source of the thermotolerant bacteria responsible for spoilage.

1. Canned Sausages

Sausages canned in 2% brine and processed at 121°C for 40 minutes at 15 psi in 300 x 410 size cans were found to be acceptable at the end of six months storage at ambient temperature. No significant change in moisture, protein and fat contents were observed throughout the storage period. The final moisture content of the sausages at the end of the storage period was 68.5% and this level is similar to the sausages prepared by the Japanese workers *(Table 2)*.

Fatty acids in fish are highly unsaturated and easily oxidised during storage. Its degree of oxidation is one of the indices to estimate the quality of fish products. The peroxide value (POV) is the reactive oxygen contents expressed in terms of milli equivalents of free iodine per kilogram of fats. It was determined by titrating liberated iodine from potassium iodide with thiosulphate. Another index that was used to estimate lipid oxidation is the thiobarbituric acid (TBA) number 2. TBA reacts with malonaldehyde which is formed from unsaturated fatty acids by oxidation. The product has a brilliant colour with an absorption maximum at 532 nm. Changes in peroxide value and TBA number of canned sausages during storage are shown in *Figure 2*.

POV is usually used to assess the rate of lipid oxidation. In the early stages of oxidation of fish lipid, correlation is obtained between oxidation and hydroperoxide content as can be seen from the sharp rise by the fourth week of storage. As lipid oxidation progresses, the POV decreases by the decomposition and reaction with other materials such as protein.

TBA reacts with carbonyl compounds, particularly malonaldehyde which are decomposition products of hydroperoxide complex. With storage, more of such compounds are liberated following lipid oxidation resulting in an increase in the TBA number.

Canned fish sausages were evaluated organoleptically using freshly prepared samples as control at intervals using the hedonic scale rating from 1 (dislike extremely) to 9 (like extremely). The product was evaluated for the followings – colour, odour, texture, taste and overall acceptance. By the end of six months the product continued to be acceptable organoleptically.

2. Chilled and Frozen Sausages

The highest temperature reached during the processing of sausages used for

Table 2. Chemical composition of fish sausage

Chemical composition	Current Study	AMANO (1965)	OKADA (1967)	TANIKAWA (1969)
Moisture content	63.7	67 – 68	68.5	86.6
Crude protein (N x 6.25)	13.7	14 – 15	15.2	15.0
Fat	5.2	5 – 6	5.9	NA
Ash	1.6	NA	NA	2.5

NA = Not available.

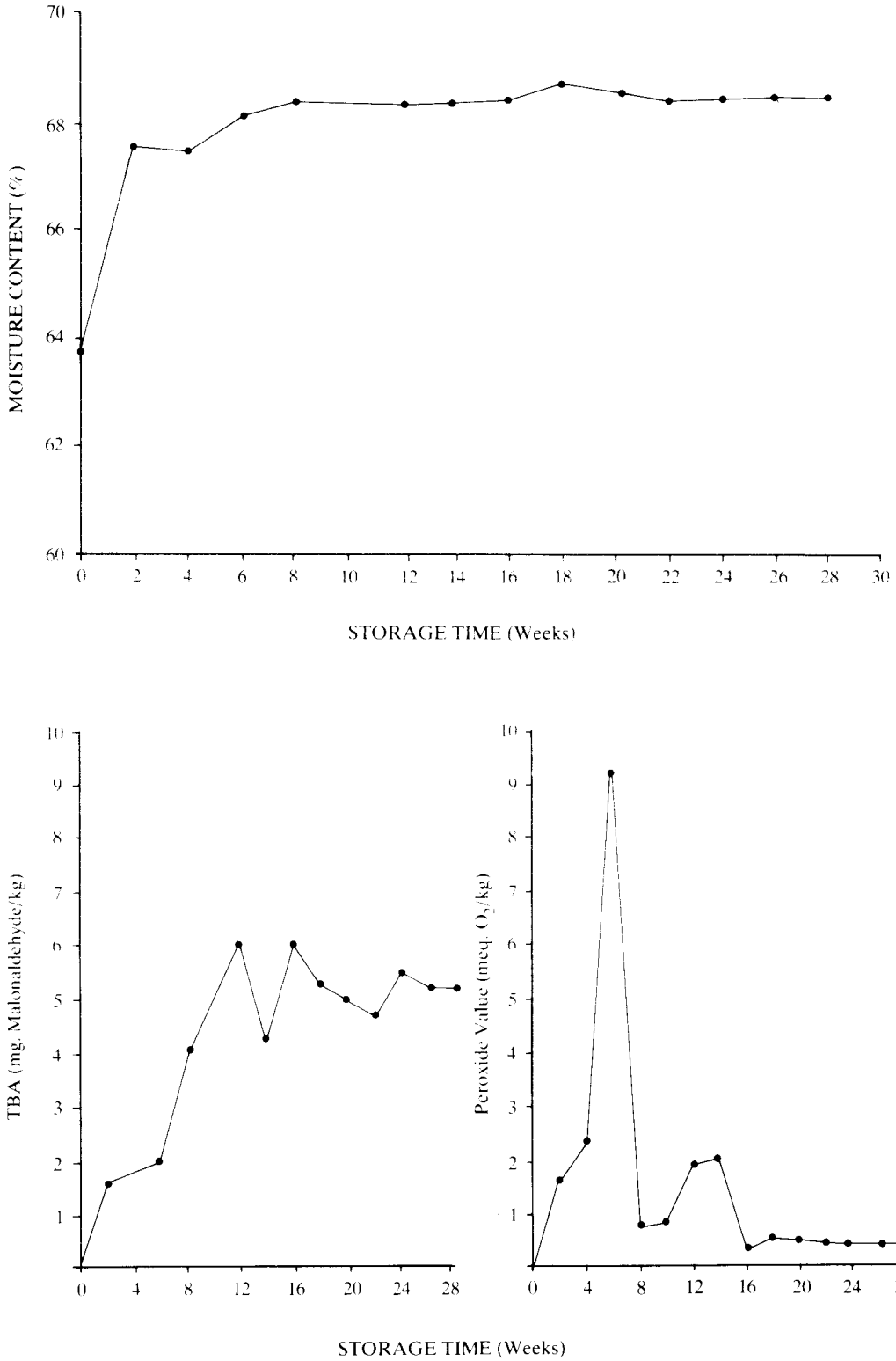


Figure 2. Chemical changes during storage of fish sausages

chilled and frozen storage was 90°C and at this temperature a considerable number of micro organisms survived. These are mainly aerobic spore bearing rods belonging to the genus *Bacillus*.

As a comparison market samples of frozen beef and chicken sausages were obtained and analysed for their microbial load. The total plate count per gramme (32°C) of commercial samples were found to range from 2.0×10^1 to 2.6×10^4. Anaerobes, coliforms and *Staphylococcus aureus* were absent in all samples analysed.

Fish sausages vacuum packed in polypropylene and stored under chilled conditions were mouldy at the end of 12 weeks. This shows that the use of preservatives is necessary to prolong the shelf life of vacuum packed sausages. Sausages vacuum packed in polyester/polyethylene laminate and frozen have a shelf life of six months with a bacterial load of 4.7×10^2 counts/g at the end of the storage period. No coliforms and *Staphylococcus aureus* were detected in any of the chilled and frozen sausages throughout the study period. The frozen sausages were slightly brittle at the end of the study period due to loss of moisture. This can be improved by the use of emulsifiers and stabilizers such as milk proteins. The recipe contains 10% beef fat and 8.0% vegetable oil and as such the use of emulsifiers would give a protective layer preventing globules from separation during processing. Milk proteins would then be involved in fat binding and texture formation without any loss in gelling capacity of the product.

RECOMMENDATIONS AND CONCLUSION

Tuna fish sausages have been successfully developed. Sausages canned in 2% brine were found to be highly rated for colour, odour, texture, taste and overall acceptability at the end of six months storage at ambient temperature. The chemical composition of the canned sausages were equivalent to those produced by similar method by Japanese workers.

Preliminary trials on vacuum packed skinless sausages stored under chilled and frozen conditions indicated that the sausages have a shelf life of 12 weeks and six months respectively based on chemical and microbiological analyses. The shelf life of chilled sausages can be prolonged by the use of preservatives.

The elasticity of the fish sausage can be greatly improved by washing deboned muscle prior to grinding followed by pressing or centrifuging off excess water. This should leach off fat and water soluble substances such as blood, flesh pigments and mucus which interferes in the gelling property of the flesh by interrupting the crosslinking of myofibrillar proteins.

Fish protein has a high biological value and could serve as a cheap source of animal protein in both fresh or processed forms. This study shows that the new product, tuna sausages, is very well accepted. It also gives insight into improved utilisation of both red (tuna, skipjack, whale etc.) and white (sharks, rays, saurida etc.) fleshed fish types. As has been mentioned earlier different species have different jelly strength and some species give decreased elasticity with decreased freshness on storage. As such selection of raw material is very important. Low market value fish can also be used thereby giving a low cost of product.

Fish sausages are easy to prepare and require no extra equipment other than those available in the canning industries. Equipment required are a meat-bone separating machine, a bowl chopper or meat grinder, stuffer, smoke house, cooker tank, seamer and retort. Tuna sausages have excellent eating properties and good keeping quality.

SUMMARY

Fish sausages have been successfully developed from tuna (*Euthynnus affinis* Cantor.). Tuna sausages have the following chemical composition – 63.7% moisture content, 13.7% crude protein (N x

6.25), 5.2% fat and 1.6% ash. Skinless sausages were canned in 2% brine and were found to be highly acceptable after six months storage at ambient temperature (30°C). No significant changes were observed chemically, or organoleptically throughout the study period. Vacuum packed skinless sausages stored under chilled and frozen conditions were found to have a shelf life of 12 weeks and six months respectively based on chemical and microbiological tests.

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Appendix I
Processing of Fish Sausage
(WAN RAHIMAH, 1974)

Ingredients	
Fish meat	3500 g
Vegetable oil	200 g
Sugar	60 g
Starch	360 g
Salt	100 g
Spice mix	16 g
Onions	40 g
Ascorbic acid	1.2 g
Polyphosphate	6.8 g
MSG	6.8 g
Red Colour	5.2 ml
Ice	400 g

Method

1. Deboning of fish
2. Thorough mixing of fish meat with ingredients.
3. Stuffing in cellulose casings at 10 cm intervals.
4. Cooking at 90°C for 1 hour.
5. Cooling in ice water for 10 minutes.
6. Boiling 1 minute.
7. Removal of casing.

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