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Original Article

Quality and Microbial Analysis of Local Salted-Fermented Paste Product (Terkin)

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ABSTRACT

The study was conducted to determine the nutritive values (crude protein, crude fiber, ether extract, moisture, dry matter, ash and nitrogen free extract) of commercial Terkin paste product which was collected from Jebel Al-aulia area (Khartoum State, 45Km south of Khartoum) and Wadi Halfa Town (lied in Sudanese-Egyptian border, North of Sudan) and to investigate the total bacterial count and pH level in order to ensure the hygienic situation of two products, using a Sudanese Standards and Metrology Organization (SSMO), SDS 3767/2007 standards. The results of this study revealed highly significant differences ($p > 0.01$) in crude protein 24.0% and 30.7%, ether extract 6.3% and 11.8%, moisture 56.4% and 39.2%, dry matter 43.6% and 60.8% and ash 13.2% and 19.1% for Jebel Al-aulia and Wadi Halfa Terkin product, respectively. The study recorded also no significant differences in crude fibre 1.5% and 1.2% and nitrogen free extracts 3.1% and 3.4% for Jebel Al-aulia and Wadi Halfa Terkin product respectively. It could be concluded that the findings of microbial analysis of studied products, the Jebel Al-aulia Terkin showed a lower level of total bacterial count (3.5×10^5 CFU/g) than Wadi Halfa Terkin product (6.2×10^5 CFU/g and pH level of studied products had recorded a higher level (7.2) in Terkin of Jebel Al-aulia than Wadi Halfa Terkin product (6.7).

Keywords: Quality, microbial, fermented product, fish, Terkin, paste

INTRODUCTION

Fish and fishery products are highly nutritious and contain high percentages of animal protein with several other nutrients such as vitamins A, B, E, and K and they are good sources of some minerals like calcium, phosphorus and iron (Lunven, 1982). Fish is important source of protein in the daily diet. However, fish also has the disadvantage that it spoils quickly. If fish is not boiled, salted, dried, smoked or preserved in some other way, it will quickly spoil. In South-East Asia, fermentation is the most important way of preserving fish. Fermented fish paste and sauces have a more important product in the daily diet than salted or dried fish (Brigitte *et al*., 2004). In Sudan, fish is distributed over an area of 100,000 km^2 of fresh-water and 760 km^2 of marine, the total sustainable production amount to 114,100 tones/year and human consumption is estimated at only 1.4 kg/year (Meske, 1985), nearly 70% of the total fish landing is cured either by salting, fermentation or sun-drying. Very little of the local fish supply is smoked, except in southern Sudan where smoked, dried and fermented fish products are very popular among the local communities (FAO, 1992a).

Terkin (fermented fish paste) is the one of traditional product in the Sudan particularly in the northern part of the country. Terkin's area famous for its production and consumption is centered on Dongola, the ancient town of Nubia region, Northern Sudan. The region has a long experience in fish fermentation (Besyuni, 1979). Traditional methods of fish fermentation (Fesseikh, Terkin) are two main techniques have clearly emerged as methods commonly practiced in many African countries. These are fermentation with salting and drying, fermentation and drying without salting and fermentation with salting but without drying (FAO, 1992a).

The microbiological examination of fish products is to evaluate the possible presence of bacteria or organisms of public health significance and to give an impression of the hygienic quality including temperature abuse and hygiene during handling and processing (WHO, 1999). According to El-Tom, (1989) and Abu Giddeire (2001) the count of microorganism increased rapidly during first fermentation days and began to decrease later, and that traditional product had a large number of micro-organisms than the laboratory products.

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Research problems are tackled to unavailability of scientific procedures and no standard level of microbial load from Sudanese Standards and Meteorology Organization (SSMO) for Terkin product. The main objective of this study to determine the nutritive value, microbial load and pH level of collected Terkin product paste (wet-salted fermented fish) from two more famous localities of its production in Sudan.

MATERIALS AND METHODS

The studied Terkin paste (wet-salted fermented fish product) samples were purchased from commercial sources of two manufacturing compasses; Elhuda Fishing Establishment located in Jebel Al-aulia dam – Khartoum State, 45Km south of Khartoum, and Mohammed El-halfawi Manufactory located in Wadi Halfa Town – North Sudan.

Jebel Al-aulia Terkin Preparation

Studied Terkin product was collected from Elhuda Fishing Establishment, located in Jebel Al-aulia Dam area; it's specialized in production of fermented fish products (Fessiekh and Terkin). Terkin was prepared and processed from small-young fish namely; Kass (Tiger fish; *Hydrocynus* spp.) and Kawara (*Alestes* spp.). The procedures of production of Terkin, whole unwashed fish (ungutted) was placed in plastic sac and sprayed with little salt, closed tightly and left for 1 – 2 days until fermentation signs appeared. Little boiled-water added and left till it ripened. The product was stirred continuously through this period until completely pasted product was achieved and cooled in steel-vessel. After cooling, 10% salt should be added. The mixture transferred to burlap, placed in clean, sandy and slope place for drainage. After drainage completed, the product transferred to a large closed-plastic-barrel and left to ferment till the desired flavour was occurred (usually 3 – 4 days in summer and increased in winter). Finally, Terkin was packed in packs "250g/pack" and sold in this manner. Shelf-life of Jebel Al-aulia Terkin product was 6 months.

Wadi Halfa Town Terkin Preparation

The other studied Terkin was collected from Wadi Halfa plants. Fish species for Terkin preparation in this plants was the same fish species as in Jebel Al-aulia Dam, but larger in its size. The large fish of *Kass and Kawara* were collected from fishermen, eviscerated, packed and treated with little salt. The fish were placed in boiled water and stirred continuously until the fish were completely pasted, and left for cooling. After that, the mixture packed in large plastic Jerri cans (about 30 kg/jerrican). Finally, sealed tightly with its covers and transferred to market for selling. Shelf-life of this product was 6 months.

Sampling Method

Generally, the large representative samples were collected according to Sudanese Standards and Metrology Organization (SSMO), SDS 3767/2007. Sampling was carried-out with aseptic precautions using sterile containers with spoon (Stool-Containers) from the two studied products. The samples were placed in a large container and transferred to the laboratories of Khartoum University (Laboratory of Animal Nutrition) and University of Sudan of Science and Technology Department of Fisheries and Wildlife Science for analysis.

Microbiological investigations

The media used to determine total viable count (TVC) was obtained in a dehydrated form as manufacturer described, the media was composed of casein enzyme hydrolysate 5.0g, yeast extract 2.5g, dextrose 1.0g and agar 15.0g. It was prepared according to manufacturer's instructions, by using 23.5g of media dissolved in 1 liter of distilled water (DW). The resulting mixture was mixed well and allowed to boil in water-bath until it was completely dissolved. Media was sterilized in an autoclave at 121˚C for 15 minutes. Finally, the media was let to cool at 45˚C and immediately poured in petri dishes for plating. Normal saline solution was prepared and used. Microbiological investigation was determined as described by Barrow and Feltham (1993). Total bacterial count (TBC), in determination of (TBC), the sterile, single-use syringes were used to transfer 1ml of a selected dilution into duplicate sterile plates. 15-20ml Plate Count Agar (PCA) were added to each plate. The plates were incubated at 37˚C for 24 hours according to International Standard, ISO No: 4832/2006. Colonies were counted and determined according to Barrow and Feltham, (1993).

pH determination

The pH value was determined at room temperature. Two grams of wet-salted fermented fish product (Terkin) were weighed in a sensitive-digital balance and blended with 20 ml distilled water and stirred well with a glass stirrer and centrifuged 2000/rpm. The pH level of supernatant was measured using glass-electrode of a newly calibrated Digital pH meter (JENWAY-3015 pH meter).

Chemical composition

Moisture content, dry matter (DM %), crude protein (CP %), ether extract (EE %), nitrogen-free extract (NFE %), crude fibre content (CF %) and ash% were determined for wet-salted fermented fish sample (Terkin) followed the AOAC (1990) method.

Statistical Analysis

The data was analysed using statistical package (IBM SPSS version 19.0), and one way ANOVA test was employed.

RESULTS AND DISCUSION

The Sudanese fermented fish product (Terkin, paste) falls in the category of Sudanese traditional fish products. The producers along the stretch of Nile seem to carry-on the job with no scientific background, but are dependent on heritage and tradition; no control is exerted over the fermentation. In this way, chances for competition in regional or world markets will not definitely succeed. This study aimed to determine and evaluate the nutritive value, microbial load

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and pH values of wet-salted fermented fish product (Terkin) in the targeted regions in Sudan, Jebel Al-aulia dam and Wadi Halfa town (Lake Nubia).

Table 1 showed that the protein content of Terkin made in Jebel Al-aulia dam was 24%, while in the Wadi Halfa was 30.7% ($p \leq 0.01$). This might be probably due to use of different salt concentrations, because Jebel Al-aulia Terkin contains 10% salt, whereas Terkin of Wadi Halfa contains a few salt, just the salt added by processors for preservation in abdomen region and surfaces of fish considered negligible. These results agreed with Agab and Shafie, (1989) and El-tom, (1989) who reported that, the protein content of wet-salted fermented fish product, prepared from Kawara (*Alestes sp*.) is ranged between 27.7 and32.9% .

There was no significant difference ($p > 0.05$) shown in the crude fibre between the two production sites. Ether extract for Jebel Al-aulia and Wadi Halfa Terkin was found to be 6.3% and 11.8%, respectively. There was a highly significant difference ($p \leq 0.01$) in fat content between Terkin of the two production sites; however, Wadi Halfa Terkin contained a higher percentage of fat than that of Jebel Al-aulia. These differences suggested being due to differences in nutritional environment, size of fish and physiological status of fish, these factors The results of this experiment were in agreement with Agab and Shafie (1989); who reported that, the fat content of Fesseikh prepared from Kawara ranged from 10.6 to 22.5%. Also, the findings agreed with Mohamoud, (1977). NFE% for Jebel Al-aulia Terkin and Wadi Halfa Terkin was 3.1% and 3.4%, respectively. As it was clearly noticeable in Table 1, there was no significant difference ($p > 0.05$) in NFE content between Terkin made in Jebel Al-aulia dam and Wadi Halfa. Moisture content of Jebel Al-aulia and Wadi Halfa, was 56.4% and 39.2%, respectively. There was a highly significant difference ($p \leq 0.01$) in moisture content between two production sites. However, moisture of Jebel Al-aulia Terkin was higher than moisture of Wadi Halfa Terkin. So, this difference suggested to be due to the difference in fish size, because, fish size of Jebel Al-aulia Terkin was smaller than fish size of Wadi Halfa Terkin, since the small fish size has higher moisture than larger ones in the same species. The results are in the lines of Agab and Shafie (1989).The results were in agreement with Agab and Shafie (1989), who figured-out that, the matter of Fesseikh prepared from Kawara ranged from 54.5 to 89.3%. Also, these results were in agreement with El-tom (1989), who reported that, Fesseikh prepared from Kawara contained 55.9–68.7% DM. Furthermore; the findings were in agreement with Mohamoud (1977), who reported that, dry matter of Fesseikh prepared from Kass contained 65.4%.

Table 1. Nutritive values of Terkin paste product collected from two production sites in the Sudan

Production site	Crude Protein %	Crude fiber %	Fat %	Nitrogen free energy%	Moisture %	Dry Matter %	Ash %
Jebel Aulia	24.0±0.21**	1.5±0.23	6.3±0.24**	3.1±0.49	56.4±0.51**	43.6±0.51**	13.2±0.31**
Wadi Halfa	30.7±0.64**	1.2±0.12	11.8±0.26**	3.4±0.62	39.2±1.01**	60.8±1.01**	19.1±0.49**

Values are means ± standard error; **: Highly Significant Differences at $p \leq 0.01$.; S.E: Standard Error. Sign: Significance

Table 2. Total viable count (TVC, CFU/g) and pH level of Terkin paste obtained from two production sites in the Sudan

Parameter	Production site	Mean ± SE
TVC	Jebel Al-aulia	$3.5\times10^5 \pm 7.7\times10^{3NS}$
	Wadi Halfa	$6.2\times10^5 \pm 2\times10^{4NS}$
pH	Jebel Al-aulia	7.2 ± 0.01**
	Wadi Halfa	6.7 ± 0.04**

CFU/g: Colony Forming Unit per gram. TVC: Total Viable Count. NS: no significant differences ($p > 0.05$). **: Highly Significant Differences at $p \leq 0.01$.

As Table 1 illustrated, the ash and dry matter content was found to be as the similar of many authors. The TVC for Jebel Al-aulia Terkin as shown in Table 2 was found to be3.5×10^5CFU/g,, whereas the TVC for Wadi Halfa Terkin was recorded 6.2×10^5 CFU/g. The findings showed that, there was no significant difference in TVC between Terkin of the two production sites. However, in spite of there was no significant difference but markedly that, Wadi Halfa Terkin recorded a higher number of total bacterial count than that of Jebel Al-aulia, so this increase in TVC probably to be due to the difference in salt concentration, because Jebel Al-aulia Terkin contains more salt than Wadi Halfa Terkin, and as we know, whenever salt concentration takes place total bacterial count expected to be low, because, increase of salt lead to increase of pH, and as we know, the preferable medium for bacteria is neutral and semi acidic (El Tom, 1989). Dirar (1993) reported that, there was no doubt, however, that bacterial enzymes contribute to flavour development in fermented sauces and pastes. The relative importance of the fish and microbial enzymes in Terkin fermentation probably depends on the procedure followed in the preparation. When the method involves an initial fermentation of the unsalted fish, for instance, the bacterial role would be expected to be pronounced as reflected in swelling of fish and the development of strong odour. These results were in agreement with Knochel and Huss (1984), who studied the microbiology of barrel salted herrings, revealed that both aerobic and anaerobic viable counts (in media containing 15 percent sodium chloride) were low, i.e. not more than 3 x 10^5CFU/g of fish. Also, Dirar, (1993) mentioned that, there

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were no official reports on food poisoning was recorded in Terkin product, but this does not negate the possibility, since that many food poisoning cases in the Sudan do not reach official channels. However, the limits for TBC (CFU/g) in fermented fish products were not found in Sudanese Standards and Metrology Organization (SSMO).

The pH values shown in Table.1 were 7.2 and 6.7 for Terkin of Jebel Al-aulia and Wadi Halfa, respectively. This was showed a highly significant difference ($p \leq 0.01$) in pH between Terkin of the two production sites. However, Jebel Al-aulia Terkin recorded a higher pH value than that of Wadi Halfa. So, this increase in pH might to be due to the increase of salt, because when the salt increased lead to increments in pH. The results of this study are showed a similarity and an agreement with findings of Agab and Shafie, (1989) and El Tom, (1989).

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