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The gross chemical composition of some traditionally processed Nile fishes from Sudan

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Abstract
The determination of gross chemical composition of processed fish showed that mandeshi made from *Synodentis* spp., had the highest calorific value (375.8) compared with other processed fish species. The digestibility of wet salted fish (fessikh) *Alestes* spp. ranged between 0.429:1.0 in eight days old, to 0.086% in mature product, respectively). The highest concentration of protein (55.125%) was found in *Synodentis* spp., processed as mendeshi and the lowest percentage (16.62%) in mature fessikh made from *Hydrocynus* spp. The highest fat proportion (15.77%) was found in mendeshi of *Synodentis*, and the lowest percentage (2.40%) was recorded in *Alestes* spp. (mature fessikh). *Labeo* spp. (mature fessikh) showed highest ash content (27.95%) while the lowest ash percentage (6.39%) was found in Kajake (*Clarias* spp.). The highest moisture percentage (55.77%) was detected in *Hydrocynus* spp. (mature fessikh), while the lowest percentage (15.18%) appeared in mendeshi of *Synodentis* spp.

Keywords: Fish, composition, products, calorific value, digestibility

Introduction
Fish is a commodity of high quality protein, rich in vitamins and micronutrients, and with low fat (Lunven) [1]. In Sudan fish is among the main sources of animal protein for Nilotic and Nubian ethnic groups (Jackson, 1923). The appreciated nutritional, and health promoting benefits of fish led to growing demand on it locally (Mahmoud) [3] and globally (Ye) [4].
Fish usually spoils rapidly by microbial activity (Yohama *et al*., El Hag *et al*.,) [5, 6]; especially when mishandled during post-harvest treatment (Abu Gideiri *et al*.,) [7]. Maximization of the economic value and safety of fish in Africa is by fish processing (Essuman; Kiin-Kabari *et al*.,) [8, 9]. This lowers the tissue water available to support spoilage microbial agents **(**Bakhiet and Khogale) [10].
Traditional fish preservation in Sudan are by Sun drying and wet salting (Mahmoud; Dirar [11]; Eltom and Abu Gideiri *et al*.,) [3, 12, 7]. The FAO [13] reported that 30% of the total freshwater fish landings in Sudan are treated accordingly. For promotion of both processing methods base-line data is needed (Abu Gideiri *et al*.,) [7]. In Sudan there are four traditionally processed fish products. These are kajake, fessikh, terkeen (maloha) and mendeshi (Dirar) [11]. Kajake is sun-dried fish product. The highly preferred type is the black one made from *Clarias* spp. **(**Garmut), followed by whitish kajake made from *Distichodus* spp. (Khareesh), and low quality one made of a number of fish market rejects species such as *Labeo* spp. (Dabs), *Synodontis* spp. (Gargour), and *Oreochromis nilotius* (Bulti), Ahmed *et al*., [14]. The bulk of fessikh is made from *Hydrocynus* spp. (Kass) and *Alestes* spp. (Kwara), (Dirar) [11] but *Labeo* spp. are equally acceptable (Eltom) [11].
Mendeshi is a pasty fermented product generally made from *Synodontis* spp., but according to Dirar ([11]) relatively high fatty fish such as *Mormyrus* spp., can be used. This study aimed to determine the gross chemical composition of traditionally dry and wet salted freshwater fish species consumed by Sudanese.

Materials and Methods
Sample collection
Salted fish used in this study were collected from Al Huda Fish Foundation (AFF) and Ismail Fish Foundation (IFF) at Jebel Aulia, and Khartoum Central Fish Market (KCFM) at Khartoum. The collected processed fish were: fessikh and/or terkeen made from *Alestes*s spp.,

and/or *Hydrocynus* spp., *Labeo* spp.; kajake made from *Clarias* spp. and *O. niloticus*, and mendeshi made from *Synodontis* spp.

Proximate analysis

The proximate composition (moisture, protein, fat and ash were determined using the standard methods of the Association of Official Analytical Chemists (AOAC, 20th Edition, [15].

Calorific value

Following Babiker [16] calorific value was determined as follows:

Calorific value = Protein%x4.1 + Fat%x9.5

Digestibility

Following Babiker [16] digestibility was determined as follows:

Digestibility = Fat % ÷ Protein %

Results and Discussion

Traditional fish preservation and its nutritive value

In Sudan dry fish (kajake) is made by gut removal and spilling the fish into long slices to accelerate water removal and hence facilitating drying. The practice is poor, unhygienic and run in exposed areas. Yet the product is on high demand in rain-fed agricultural schemes due to its shelf life. Wet salted fish production is witnessing improvement due to production practices by modern enterprises. On the other hand, traditional production of fessikh and terkeen using poor plastic and/or tin containers is practiced on large scale mostly by the gender. For research purposes and homemade fessikh clean plastic buckets with tight cover are used. Fesseikh is popular not only by the Nubian ethnic groups but it is also an appreciated meal by others. Salting is applied to relatively lean fish and the Sudanese consumer prefers little fat in the salted products (Dirar [11]). According to Ray and Joshi [17] drying and wet salting of fish are methods of prolonging its shelf life, and were probably in practice in Sudan around 1500 BC.

Traditional fish preservation practices are easy, require no special skills and cost effective. It can be easily transported to local markets or exported to Egypt (fessikh) or to Chad and Central African Republic (kajake).

An important measure of food value of a fish is its content of fats and protein (Babiker) [16]. Wet salting inflict no changes in the amino-acids and the mature product bear desirable organoleptic flavours Zang *et al*., [18]. According to Rabie *et al*. [19] this is due to enzymatic and microbiological activity in the fish muscle, leading to changes in free amino acids, biogenic amines and polypeptides consequently contributing towards nutrition.

The gross chemical composition of traditional processed fish

The gross chemical composition of processed fish is given in Table 1. Insignificant differences in gross chmeical composition is found between 8 old or mature *Alestes* spp. fessikh indicating that this fish species ferminted earlier as fessikh. The discripancy between chemical values of *Hydrocynus* spp., was apprent. Terkeen values were comparable. Kajake of *Clarias* spp., seems to be more nutritive than of *O. niloticus*. Mendeshi showed wide range in its chemical values except for ash.

According to Mahmoud [3] the general gross chemical composition of fresh fish is around 80% moisture, 18% protein, 1% fat and 1% ash. This ideal composition varies with respect to species, locality, season and processing.

Moisture content

Table 1 showed that the moisture content of processed fish is almost 50% lower than that of fresh fish. Mahmoud [3] found that drying and/or wet salting significantly reduced the moisture content of some common Nile fish fleshes (*O. nilotoicus, Hydrocynus forskalii, Labeo niloticus, Claris* spp., *Synodontis* schall and *Labeobarbus bynii*). According to Ahmed *et al*., [21] and Bakhiet and Khogalie [10], in *Hydrocynus* spp.; El Haj *et al*., [6] in *Labeo* spp.; Mohammed, [22] and Kasozi *et al*., [23] in *Alestes* spp., wet salting significantly decreased (p<0.05) total bacterial count and tissue moisture content.

Protein, fat and ash (NaCl)

Drying and wet salting significantly increased the protein and ash content as water loss led to their concentration, in addition to salt absorption to maintain tissues ionic balance (Table 1). Similar findings were reported by Mahmoud [3], Bakhiet and Khogalie [10], El Haj *et al*., [6] and Kasozi *et al*., [23]. Fat content increased due to water removal, but its polyunsaturated fatty acids are reduced by salting (Chukwu and Shaba) [24].

Calorific value and digestibility

Table 1 showed that the highest calorific value was recorded in mendeshi, followed by Kajake, terkeen and fessikh. During preparation of mendeshi corn flour was added which led to increase in its calorific value, depending on the amount added. According to Chukwu and Shaba [24] fish salting leads to denaturation and reduction of its polyunsaturated fatty acids. This contributes to lowering of the calorific value. This is advantageous for people who want to keep low calories in their diet (Babiker; Elsayed *et al*.,) [16, 24]. According to Babiker [16], Chukwu and Shaba [23] low fat to protein ratio is indicative of high digestibility. This is highly applicable to the processed freshwater fishes of Sudan (Table 1).

The differences in gross chemical composition has wide corelation such as species, season, location, processing etc. In the present study *Labeo* spp., showed 33.9% moisture, 32.3% protein, 5.0% fat and 27.9% ash while, Sarower-E *et al*., [25] found 27.6% moisture, 66.8% protein, 13.4%f at and 16.6% ash in *Labeo bata*. Dry *Clarias* spp. (Table 1) showed 50.9% moisture, 42.8% protein, 12.7% fat and 6.0% ash while, Abraha *et al*. [26], in sun dried fish, found 15.6% moisture, 61.2% protein, 1.9% fat and 3.6% ash. In the present study *Synodontis* spp. showed mean values of 34.6% moisture, 36.7% protein, 11.2% fat and 22.1% ash while, Abraha *et al*., [26] repotrted14.2% moisture, 49.7% protein, 1.1% fat and 2.9% ash in *Synodonti* spp.

Conclusions

The study concluded that synchronised microbiological, chemical and sensory analyses are to be run for all traditionally processed fishes. This is vital for accessing the suitability of the processed fish for human consumption. Extensive *in vivo* and toxicological studies are also needed to meet Sudan metrological standards

Table 1: Fish species, days of wet salting and growth chemical composition (all samples are wet salted, except kajake which is sun dried unsalted, ≥25 days is mature product)

Species	Source*	Days	Moisture%	Protein%	Fat %	Ash%	Calorific Value	Digestibility
Alestes spp. Fesseikh	HFF	8	37.32	24.50	10.52	21.55	200.43	0.430 :1.0
		9	48.73	21.88	05.88	22.86	145.59	0.20 :1.0
		10	32.68	31.50	12.78	27.30	250.60	0.406:1.0
		13	48.71	22.75	03.11	22.78	122.80	0.137:1.0
		25	38.04	22.75	09.56	22.29	184.08	0.420 :1.0
		.>25	40.83	25.38	07.92	23.34	179.30	0.312 :1.0
Hydrocynus spp Fesseikh	IFF	8	40.64	23.63	05.15	23.58	145.77	0.218:1.0
	KCFM	12	54.20	17.5	04.85	15.83	117.81	0.277 :1.0
		>25	49.56	25.38	05.23	20.14	153.76	0.206 :1.0
		>25	55.78	16.63	05.26	17.44	118.09	0.316 :1.0
		>25	43.66	22.75	04.89	20.55	139.69	0.214 :1.0
Hydrocynus and *Alestes* spp Terkeen	HFF	25.	42.71	22.75	09.27	22.50	181.30	0.407 :1.0
		>25	42.51	22.53	09.13	22.40	179.14	0.405 :1.0
Labeo spp. Fesseikh	HFF	>25	33.91	32.38	05.00	27.96	180.26	0.155:1.0
Synodontis spp Mendeshi	KCFM	>25	15.18	55.13	15.78	16.29	375.89	0.286:1.0
			54.22	18.38	6.80	17.93	155.95	0.370 :1.0
Oreochromis niloticus Kajake	KCFM	>25	44.64	21.88	08.21	13.52	167.66	0.375 :1.0
Clarias spp."Kajake			50.96	42.88	12.75	6.00	296.91	0.297:1.0

*Huda Fish Foundation (HFF), Ismail Fish Foundation (IFF), Khartoum Central Fish Market (KCFM)

References

1. Lunven P. The Role of fish in human Nutrition. Food Nutr. 1982; 8(2):9-18.
2. Jackson HC. The Nure of the Upper Nile Province, Part C. Sudan Notes and Records. 1923; 6:59-189.
3. Mahmoud ZN. Meat Quality of Some Common Nile Fishes. M. Sc. Thesis Department of Zoology, Faculty of Science, University of Khartoum, Sudan, 1977.
4. YeY. Historical consumption and future demand for fish and fishery products: exploratory calculations for the years 2015/2030. FAO Fisheries Circular No. 946. Rome, FAO. 1999, 31.
5. Yohama J, Fulani A, Aka U, Amax W. Prospects for adaptable technological innovation in fresh fish processing and storage in rural area of Domal, L. G. A. of Nasarwa a state. J Agric. Sci. 2011; 3(3):282-286.
6. El Hag GA, Abu Gideiri YB, Ali ME, Abu Zied IM. Nutritive value and microflora of salted Kawara (*Alestes* spp.) during storage. Researcher. 2012; 4(2):69-76.
7. Abu Gideiri YB, Ali ME, Mahmoud ZN. Post-harvest Treatment of Nile Built (*Oreochromis niloticus*), Department of Zoology Research 1999; 1:52.
8. Essuman KM. Fermented fish in Africa: A Study on Processing, Marketing, and Consumption. FAO Fisheries Technical Paper; 1992, 329.
9. Kiin-Kabari DB, Barimalaa IS, Achinewhu SC, Adeniji TA. Effect of extracts from three indigenous species on the chemical stability of smoke-dried catfish (*Clarias lezera*) during storage. Fri. Food, Agric., Nutr and Develop. 2011; 11(6):5335-5343.
10. Bakhiet HHA, Khogalie FAE. Effect of different salt concentration on chemical composition of the fish *Hydrocynus* spp. J Animal Feed Res. 2012; 6(1):461-464.
11. Dirar HA. Flavours and subtitles. The Indigenous Fermented Foods of the Sudan: A Study in African Food and Nutrition. Ed. Ox son Cab International, UK, Wallingford, 1993, 411-476.
12. Eltom AM. Microbiology and biochemistry of fessiekh fermentation. M. Sc. Faculty of Agriculture, University of Khartoum, Sudan, 1989.
13. FAO. Fermented fish in African food and nutrition. CAB international, Wallingford, 1992.
14. Ahmed RAM, Hammad NMH, Mahmoud ZN. Bacteria of some Traditionally Processed Freshwater Fish in Sudan. International Journal of Agriculture and Environmental Research. 2019; 5(5):684-698.ISSN: 2455-6939.
15. AOAC. Association of Official Analytical Chemists. 17th Edition, 2016.
16. Babiker MM. Dietary Nile fishes are classification according to nutritional merits. Sudan Notes and Record. 1981; 62:161-170.
17. Ray RC, Joshi VK. Fermented foods: Past, present and future scenario. In: Ray RC, Montet D, eds. Microorganisms and Fermentation of Traditional Foods. Boca Raton, Florida, USA: CRC Press. 2014; 1-36pp. Accessed on 31 March 2020.
18. Zang J, Xu Y, Xia WJ, Regentein J. Quality, functionality, and microbiology of fermented fish: a review. In Critical Reviews in Food Science and Nutrition. 2019; 60(11):1-15.
19. Rabie M, Simin-Sarkadi L, Siliha H, El-seedy S, El Badawy AA. Changes in free amino acids and biogenic amines of Egyptian salted-fermented fish (Feseeekh) during ripening and storage. Food Chemistry. 2009; 115:635-638. DOI: 10.1016/j.foodchem. Accessed on 31 March 2020.
20. Ahmed EO, Ali ME, Hamid AA. Quality Changes of Salted Kass (*Hydrocynus forskalii*) During Storage at Ambient Temperature (37±1ºC). Pakistan Journal of Nutrition. 2010; 9(9):877-881.
21. Mohammed HMH. Nutritive value of fresh and salted fermented fish (*Alestes dentex*) Terkin. M. Sc. Thesis (Food Science and Technology) Department of Food Science and Technology, Faculty of Agriculture, University of Khartoum, Sudan, 2010.
22. Kasozi N, Namulawa VT, Degu GI, Kato CD, Mukalazi J. Bacteriological and physicochemical qualities of traditionally dry-salted Pebbly fish (*Alestes baremoze*) sold in different markets of West Nile Region, Uganda. African Journal of Microbiology Research Bacteriological. 2016; 10(27):1024-1030.

23. Chukwu O, Shaba IM. Effects of drying methods on proximate compositions of catfish (*Clarias gariepinus*). World J. Agric. Sci. 200; 5(1):114-116.
24. Elsayed BB, Mahmoud ZN, Elhag EA. On the chemical composition of the fish *Eutropius niloticus* (Schilbidae). Sudan Notes and Records N. S. 2002; VI:219-225.
25. Sarower-E MD, Hossain MB, Minar MH. Biochemical Composition of an Endangered Fish, *Labeo bata* (Hamilton, 1822) from Bangladesh Waters. American Journal of Food Technology. 2012; 7(10):633-641.DOI:10.392/ajft.2012.633.6410. Accessed on 28 March 2020.
26. Abraha B, Admassu H, Mahmud A, Tsighe A, Xia WS, Yang F. Effect of processing method on nutritional and physico-chemical of fish: a review. Food Processing and Technology. 2018; 6(4):376-382. DIO: 10.15406/mojfpt. Accessed on 3 April 2020.