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Quality evaluation of fried fish sold in Katsina metropolis

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Abstract
The quality evaluation of fried fish sold in Katsina metropolis was studied. Five fried fish samples were obtained each week for a period of eight weeks from January to March 2024. The samples were collected from five sampling locations in Katsina metropolis (WTC roundabout, Goruba road, Tudun katsira, Katsina central market and Kofar marusa) and were taken to the. Laboratory, Umaru Musa Yar'adua University for proximate and bacterial determination (count). Ten taste panelists were randomly selected for the sensory evaluation of the fried fish products which was graded based on the hedonic scale provided. The result of the proximate composition revealed that crude protein and moisture varied significantly ($p<0.05$) in some weeks. The lipid content of the fried fish products was not significantly different ($p>0.05$) among some weeks. The result of the sensory evaluation was found to be changing throughout the period and there is significant difference ($p<0.05$) in the fried products from the five sampling locations. Also the result of the bacterial determination was found to be fluctuating due to unfavorable weather condition, frying dehydrates the fish flesh and therefore kills many bacteria. There is need for further research into the in-depth investigation of both proximate, microbial and sensory evaluation in the study area to give true picture of what consumers buy.

Keywords: Frying, proximate composition, sensory evaluation bacteria

1. Introduction
Fish and fish products are highly nutritious with protein content of 15 - 20 percent and are particularly efficient in supplementing the cereal and tuber diets widely consumed in Africa (Osibona *et al.*, 2009) [10]. It was further reported that in Nigeria, fish is regarded as a major food item contributing a total of 40 percent to dietary protein consumption. It is also preferred as a reliable source of animal protein with balanced amino acids, vitamins and essential minerals for healthy growth, Foran *et al.* (2005) [6] reported that fish is highly proteinous food consumed by a larger percentage of people because of its availability and palatability. Comparatively, fish meat is safer, healthier and a more excellent protein source due to its amino acid composition and digestibility than that of other protein sources like goat, chicken and meat of higher animals.

Determination of some proximate profiles such as protein content, lipid, ash and other nutrients is often necessary to ensure that they are within the range of dietary requirement and commercial specifications (Watchman, 2000) [17]. The study of macro nutrients present in living organisms is of biological importance because such macro - nutrients take part in some metabolic processes and are known to be indispensable to all living organisms. Fish contain small amount of these macro - nutrients some of which are essential nutrients, being components of many enzymes system and metabolic mechanisms that contribute to the growth of the fish. The chemical composition of a particular species often appears to vary from one fishing ground to another and from season to season but the basic causes of change in composition are usually variation in the amount and quality of food the fish eats and the amount of movement it makes (Hoffman *et al.*,1992) [7]. The fat composition of fish is susceptible to various factors such as time of the year and food available. Processing and cooking may also alter result in alteration to the nutritional composition of fish. Olokor (2001) [11] reported that fish losses arising from bacteria and autolytic spoilage are enormous.

Such losses, which entail a complete loss in quality and value of fish may occur at any stage between capture, processing, transportation, and marketing of the products. Losses of up to 1 million naira resulting from post-harvest handling have been reported in the Kainji lake basin. It is imperative to preserve and process fish to prolong its shelf life and to prevent subsequent loss of fish. This study, therefore, is aimed at investigating the proximate composition, sensory evaluation, and determination of bacterial load of fried fish products in Katsina metropolis.

2. Materials and Methods

2.1 Description of Sample Site

Katsina metropolis is the capital of Katsina State which is located at the northwestern part of Nigeria. It is populated by Hausa-Fulani people and the town is the capital of Manlamawa district of Katsina Emirate. The LGA was established in 1991. Katsina state has an area of 24.192km2 and a population of 5,792,578 according to the 2006 census. It lies on latitude of 7.63˚E and a longitude of 12.37˚N. It is characterized by scrub vegetation with wooded savanna in the south. The survey took place in the katsina metropolis under wakilin gabas ward II.

2.2 Sample Collection and Treatment

Fried fish samples were purchased from the different processing locations already identified in the Katsina metropolis. The experiment was set to cover a period of eight weeks from January to February 2024. Each week, samples were procured from the processors and later were brought to the Chemistry and Microbiology Laboratory, Faculty of Science Umaru Musa Yar'adua University for analysis. The sampling stations were as follows: Katsina Central Market, Kofar Marusa, WTC roundabout, Goruba road, and Tudun katsira.

2.3 Proximate composition

Moisture was determined by oven drying the samples of the fried fish products obtained from the five sampling locations at 105°C for 24 hours. Crude protein was determined by the micro kjeldhl methods as described by AOAC (2002) [2].

2.4 Bacteriological test

Bacteriological analysis was conducted in triplicate using the standard plate count/. One gram of fried products for each of the five locations was diluted into 9mls of diluted water (1g: 9mls) in sterilized universal tube (Ogunduna, 1989) [9].

2.5 Sensory evaluation

The sensory assessment of the fried fish samples was conducted at the Fisheries Laboratory, Hassan Usman Katsina Polytechnic. A six-point hedonic scale was used to score the assessment of the judges as suggested by Clucas, (1981) [3].
The ranking scale is as follows; extremely acceptable-6, Very acceptable-5, slightly acceptable-4, slightly inacceptable-3, very unacceptable-2, extremely unacceptable-1.

2.5.1 Taste Panelist

Ten taste panels were selected from students of the Department of Fisheries for the organoleptic assessment of the fish samples (using questionnaire). The taste panelists were all efficient in sensing odour, smell and feeling, Similarly, efforts were made to ensure that they are non-smokers. Every week, samples were brought to the tasting room on special plates to allow the panelists taste and record their observations based on the hedonic scale provided.

2.6 Statistical Analysis

The data obtained were analyzed on the level of biochemical and sensory evaluation of the fried fish samples. Analysis of variance (ANOVA), with descriptive statistics, was employed, using SPSS computer package version 23. Where significant differences exist between the treatments, Duncan Multiple Range Test was used to separate the means

3. Results

Table 1 shows the proximate composition of fried fish samples from the sampling locations for eight weeks. The result of the proximate composition shows that there was significant difference (p<0.05) between the weekly mean composition in all the parameters examined, with moisture values ranging from 43.04% to 55.31%, protein from 17.50 to 21.64, lipid from 5.13 to 7.31 ash from 7.09 to 9.76 and NFE 13.21 to 18.29.

Table 1: Combined mean weekly e composition of fried fish sample

Weeks	Parameters				
	Moisture	Protein	Lipid	Ash	NFE
Week 1	43.04±4.31^{a}	21.64±4.59^{c}	7.31±1.29^{c}	9.78±2.56^{c}	18.29±8.21^{b}
Week 2	47.29±4.23^{b}	21.64±4.59^{bc}	7.31±1.29^{bc}	9.78±2.56^{abc}	18.29±8.21^{ab}
Week 3	48.48±4.12^{b}	19.79±1.40^{b}	5.13±0.76^{a}	8.62±1.73^{bc}	17.34±4.41^{ab}
Week 4	52.89±3.38^{cd}	18.42±1.13^{b}	7.70±1.00^{c}	7.76±1.91^{ab}	13.21±3.83^{a}
Week 5	55.31±2.20^{d}	17.50±1.21^{a}	6.76±0.82^{ab}	7.09±1.25^{a}	13.42±3.35^{a}
Week 6	52.00±2.68^{c}	19.05±3.17^{ab}	5.23±0.53^{a}	8.00±1.88^{ab}	14.81±6.30^{ab}
Week 7	51.66±3.39^{c}	19.33±2.36^{ab}	6.09±0.45^{a}	8.47±1.32^{abc}	14.60±6.39^{ab}
Week 8	53.26±2.82^{cd}	18.33±1.33^{ab}	5.25±0.45^{a}	7.77±0.93^{ab}	14.53±1.84^{ab}

Note: Means±SD with same superscripts on same column are not significantly different (p>0.05)

Table 2 shows the organoleptic assessment of the fried fish products, with Kofar Marusa having the highest value in texture (4.7±0.78) and Katsina central market having the least in odour.

Table 2: Taste panels scores of fried fish from five sampling locations

	Location	Odour	Flavour	Texture
1	WTC roundabout	3.0±0.78	4.2±1.20	3.5±0.84
	Goruba road	3.6±1.27	2.5±0.96	4.5±0.99
	Tudun katsira	4.0±1.89	2.1±0.74	3.0±0.87
	K/central mkt	3.9±1.81	2.8±1.02	2.2±0.96
	K/marusa	4.2±0.96	3.9±0.92	2.5±1.81
2	WTC roundabout	3.4±0.84	2.8±1.78	4.7±0.78
	Goruba road	3.0±1.91	2.7±0.94	3.3±1.73
	Tudun katsira	2.6±0.74	3.9±0.91	2.0±0.63
	K/central mkt	2.3±0.66	1.7±0.78	2.9±0.81
	K/marusa	2.5±0.78	2.2±1.13	1.4±0.12
3	WTC roundabout	1.9±1.24	1.4±0.99	3.6±1.90
	Goruba road	4.4±1.81	2.7±1.12	3.2±1.80
	Tudun katsira	4.3±0.22	3.9±0.91	2.0±0.63
	K/central	4.4±1.82	3.1±1.04	2.1±0.95
	K/marusa	3.6±1.11	4.8±1.78	1.0±0.89
4	WTC roundabout	3.3±1.69	3.5±1.81	3.9±0.86
	Goruba road	2.9±1.11	4.2±0.72	3.1±0.95
	Tudun katsira	2.5±1.69	2.1±0.77	3.6±1.11
	K/central mkt	3.6±0.96	2.5±1.11	2.7±0.84
	K/marusa	2.4±0.16	3.6±0.94	4.2±0.74
5	WTC roundabout	1.5±0.66	4.1±0.19	1.9±0.66
	Goruba road	3.4±0.89	3.0±0.78	2.1±1.78
	Tudun katsira	2.8±0.97	2.3±1.20	3.6±1.23
	K/central mkt	3.0±0.19	2.5±0.22	1.9±0.76
	K/marusa	2.6±0.22	4.8±0.66	2.7±0.76
6	WTC roundabout	1.6±0.78	3.9±1.21	2.1±0.66
	Goruba road	2.7±1.18	3.1±0.74	2.9±0.98
	Tudun katsira	3.3±0.12	2.9±0.64	2.4±0.33
	K/central mkt	2.6±0.77	4.4±0.55	4.2±0.12
	K/marusa	2.8±0.66	4.2±0.25	1.8±1.25
7	WTC roundabout	3.5±1.68	1.1±0.32	1.0±0.98
	Goruba road	2.9±0.21	1.6±0.81	2.6±0.13
	Tudun katsira	4.2±0.77	3.8±0.18	2.3±0.68
	K/central mkt	2.6±1.17	2.9±0.61	1.7±0.86
	K/marusa	3.0±0.16	2.3±1.61	2.5±0.18
8	WTC roundabout	2.2±0.78	1.8±1.21	2.7±0.95
	Goruba road	3.0±0.34	4.5±1.81	2.8±0.13
	Tudun katsira	2.1±0.11	2.9±0.61	4.9±0.81
	K/central mkt	1.2±0.12	2.8±0.67	2.8±0.21
	K/marusa	4.1±0.61	4.0±0.28	3.8±0.12

Table 3 presents the microbiological count of the fried fish samples. With Kofar marusa having the highest value (72) and Tudun katsira (15) the least.

Table 3: Mean weekly bacterial count for the fried fish production

	Location	Mean count	Standard (Cfu 1g)
1	WTC roundabout	36	3.6×10^6
	Goruba road	53	5.3×10^6
	Tudun katsira	46	4.6×10^6
	K/central mkt	38	3.8×10^6
	K/marusa	72	7.2×10^6
2	WTC roundabout	40	4.0×10^6
	Goruba road	35	3.5×10^6
	Tudun katsira	50	5.0×10^6
	K/central mkt	61	6.1×10^6
	K/marusa	23	2.3×10^6
3	WTC roundabout	22	2.2×10^6
	Goruba road	33	3.3×10^6
	Tudun katsira	40	4.0×10^6
	K/central mkt	41	4.1×10^6
	K/marusa	42	4.2×10^6
4	WTC roundabout	67	6.7×10^6
	Goruba road	45	4.5×10^6
	Tudun katsira	15	1.5×10^6
	K/central mkt	41	4.1×10^6

	K/marusa	65	6.5×10^6
5	WTC roundabout	50	5.0×10^6
	Goruba road	62	6.2×10^6
	Tudun katsira	20	2.0×10^6
	K/central mkt	38	3.8×10^6
	K/marusa	29	2.9×10^6
6	WTC roundabout	32	3.2×10^6
	Goruba road	34	3.4×10^6
	Tudun katsira	15	1.5×10^6
	K/central mkt	60	6.0×10^6
	K/marusa	48	4.8×10^6
7	WTC roundabout	68	6.8×10^6
	Goruba road	39	3.9×10^6
	Tudun katsira	36	3.6×10^6
	K/central mkt	51	5.1×10^6
	K/marusa	53	5.3×10^6
8	WTC roundabout	38	3.8×10^6
	Goruba road	55	5.5×10^6
	Tudun katsira	27	2.7×10^6
	K/central mkt	40	4.0×10^6
	K/marusa	30	3.0×10^6

4. Discussion

The proximate composition, bacteriological assessment and sensory evaluation of fried fish were evaluated, Results of the proximate compositions revealed that frying have direct effect on the fish's nutritional quality. The proximate compositions showed unsteady values in the fried fish sample analyzed, with moisture having the highest values and ash had the least. The study conforms to that of Magawata and Ahmed (2014) [8] where the moisture content was in the range of 40-50%. The increase in moisture content in some samples could be due to water content in the fish which was not totally removed during frying. Week 5 had the highest in moisture (55.31%) and Week 1 had the least value (43.04%). The percentage of moisture content were in the range given by Eyo (2001) [5]. Drying and frying of fish remove moisture content making it unavailable for the spoilage activities of bacteria (Eyo, 2001) [5].

The weekly protein content of the fried fish samples differed significantly in some weeks. The variation in the protein content may be due to the fact that moisture removed made the protein to be more concentrated. Almost all the fried fish samples had the average protein content between 17% to 21%. There was no significant difference between the values obtained in protein content of week 6, 7 and week 8. In a study conducted by Steffens (2006) [14], protein formed the largest quantity of dry matter in the fish samples. However, the present study contradicts Steffens which could be due to the sample differences, species differences, feed or environment.

According to Ackman (1989) [1] fish species are generally grouped into categories based on their fat content. Lean <2%), low fat 2.4%, medium fat 4.8% and high fat > 8%. It has been indicated that the moisture is an indication of its relative lipid and protein contents of the fish (Dempson *et al*, 2004) [4]. The present study followed the trend of the of the research conducted by Paul and Vivian (2011) [13] that fat content is inversely proportional to the moisture content in some weeks.

Week 4 had the highest value of fat (7.70) and week 3 had the least value (5.13). The present study conforms to that of Eyo, (2001) [5] where fat content varies more widely than any other component of fish.

Omotosho *et al* (2011) [12] defined ash as the mineral of any food substance including fish. Week 1 and week 3 have the highest ash value (9.78) and Week five had the least (7.09). There was no significant difference between the values obtained in ash content of week 6 and that of week 8.

4.1 Sensory evaluation of the fried fish samples

The present study conforms to that of Magawata and Ahmed (2014) [8] where the values were found to be changing throughout the study period. There was no significant difference between the values obtained in odour of Goruba road (3.6±1.27) in the first week and Kofar marusa (3.6±1.11) in the third week WTC roundabout (1±0.98) in the seventh week and Kofar marusa (1±0.88) in the third week had the least value in texture which might be due to rancidity. Kofar marusa had the highest value in flavor (4.8±0.6.6) which could be due to additives added during the processing. The study also conforms to that of Umar *et al*., 2018 on sensory evaluation of African catfish smoked with melon shell and firewood. Who reported that there was no significant difference between the values obtained on sensory evaluation in the study.

4.2 Microbiological count

Frying removes water from the fish flesh and kills many of the bacteria in the fish (Taofiq, 2005) [16]. The presence of moisture in fried fish permits the growth of bacteria and mold in fish flesh during storage (Eyo, 2001) [5]. Kofar marusa have the highest value of bacteria (72) due to the presence of dust, drainage, too much heat or might be due to deterioration or that the samples were mal handle before processing or the products were exposed to environmental condition for a long period of time. The lowest number of bacteria was found in Tudun katsira because they normally start their frying in the morning and the fried products are always covered to prevent dust, flies and micro - organisms from attacking it, the activity of micro-organisms is reduced or slowed down at low temperature that is the environment is not conducive for bacteria growth (Eyo, 2001) [5].

5. Conclusion

In conclusion, the result of the protein content for week 1 and week 2 was higher than that of week 3 and week 4 which could be due to feed intake and location. The result of the sensory evaluation was found to be changing throughout the experimental period, Kofar marua had the least value (1.1±0.32) of flavor in the seventh week which could be due

to deterioration. The result of the bacterial determination was also found to be fluctuating due to some reasons like unfavorable weather condition.

6. Recommendation

- Containers used in frying should always be clean.
- There is need for further research in to the in depth investigation of both proximate, microbial determination and sensory evaluation at various locations in Katsina state to give true picture of what consumers buy.

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