Nigerian J. Anim. Sci. 2020 Vol 22 (2):306-317 (ISSN:1119-4308)

Influence of sensory attributes and storage media on quality of meat floss ‘‘*dambun nama’’* processed from white meat

Zahraddeen*[1], D., Butswat[2] I. S. R., Jama’a[3], N. A., Sir[4], M. S., Musa[1], R. S., Balarabe[1], S. and Aliyu[i], Z. I.

[1]Department of Animal Science, Ahmadu Bello University, Zaria, Nigeria, [2]National Open University of Nigeria, Abuja, Nigeria, [3]Department of Animal Production, Abubakar Tafawa Balewa University, Bauchi, Nigeria [4]Department of Animal Science, Federal University of Kashere, Gombe State, Nigeria

***Corresponding Author:** zdzariya@yahoo.com **Telephone Number:** +2348024078638*

***Target Audience:** Meat entrepreneurs, Processors, Researchers, Consumers, Policy makers*

Abstract

This study investigated the effects of storage period (≤ 5 weeks) and packaging media (glassware and stainless steel containers) on the quality of dambun nama processed from white meat (mature local chicken, duck, guinea fowl, turkey and fish). The results showed that there were significant (P<0.05) differences among the white meat type with respect to taste, appearance, tenderness, colour and acceptability. The results also revealed that flavour and aroma did not differ significantly across the meat types. There were many significant and positive correlations among the attributes studied. For instance, correlations between appearance vs colour (r = 0.66) (P<0.05) while the least correlation was between tenderness vs acceptability (r = 0.24) (P<0.05). However, the results also revealed significant (P<0.05) differences in the storage of dambun nama from the white meat studied. The quality of the product deteriorated with the increase in storage period. Dambun nama stored at lower weeks (1st and 2nd weeks) were better than those kept at 4th and 5 th week. However, dambun nama processed from guinea fowl and turkey meat deteriorated faster than the other types of white meat (fish, local chicken and duck) in terms of the total fungal and bacterial counts. However, at 5th week of storage dambun nama from duck meat had the lowest total microbes of 16.5 x 10^4cfu/g and followed by local chicken with 18.0 x 10^4cfu/g. There were also significant (P<0.05) differences in the storability of the two media; with stainless steel container having the lowest counts in terms of both the fungal and bacterial counts than glassware medium. The study suggests that variation existed in the shelf-life of dambun nama processed using the different white meat. Storage of dambum nama in stainless steel containers prolonged the shelf-life longer than glassware containers. It is also suggested that most panellists showed preference towards dambun nama from turkey and local chicken meat. However, the less preferred white meat can be greatly improved through artificial manipulation of the sensory attributes that have strong relationships.

***Key words:** White meat, Dambun nama, Sensory attributes, Storage media*

Description of Problem

Meat is a nutritious, protein-rich food which is highly perishable and has a short shelf-life unless preserved and stored [1]. The quality of meat has been related to the amount of fat which is distributed uniformly throughout the muscle. The quality is also related to the age of the animal; the younger the animal the better the quality [2].

It is reported that white or light meat refers to the lighter coloured meat of poultry as contrast with dark meat [3]. White meat may also refer to any lighter-coloured meat as contrasted with red meat like beef and some types of game. White meat is made up of fast-twitch muscle fibres, while red or dark meat is made up of muscles with fibres that are slow-twitch. Meat consists of lean, fatty tissues, and

may be fresh, cured, dried or processed into different products. The different meat products indigenous to Nigeria and some neighbouring countries that enjoy wide acceptability among the locals[4]. Meat floss (*dambun nama*) has been described as one the excellent meat products [5] that has potential for economic exploitation among tourists and other international communities.

Meat products like duck meat has been reported to be uniquely tasty and nutritious. It has been appreciated for these qualities, especially when food was in short supply, while guinea fowl is a promising genetic resource for evolving a low input-grain saving poultry alternative for production in the developing world in which the meat is similar to other poultry meat like chicken, duck and turkey [6]. Turkey occupies an important position next to chicken, duck, guinea fowl and quails in contributing the most evolving section, which is playing an important role in argumenting the economic and nutritional status of varied population. Fish is a key ingredient on the global menu, a vital factor in the global environment and an important basis for livelihood worldwide [3]. Fish is widely acceptable because of its high palatability, low cholesterol and tender flesh, when it is fresh, but more often smoked-dried or oven powdered fish is a critical source of dietary protein and micronutrients for many isolated communities in rural areas [7].

Measure of meat quality include indices such as flavour, tenderness, palatability, aroma, colour and juciness, which are the major and most appreciated characteristics of meat being consumed [8]. Organoleptic analysis is one of the oldest means of quality control, but in principle is an essential part of the mandatory assessment of food quality, while also examining the deeper study of the interdependence between physiological and psychological phenomena in the very process of perception of sensory qualities [9]. Many authors note that the sensory analysis allows manufacturers to identify, understand and respond to consumer preferences more effectively [10].

Meat deterioration begins soon after the animal has been slaughtered due to chemical changes, enzymatic actions and microbial activities which may result in the oxidative rancidity, discoloration, moldiness, off flavour, slimness [11]. The major sources of these deteriorative changes are the micro-organisms which render the meat unacceptable and unfit for consumptions. Meat is highly perishable with short shelf-life unless properly stored and preserved. Shelf-life and maintenance of meat quality are influenced by a number of interrelated factors including pre- and post-slaughter hygiene practices [12], holding temperature [12].

In Nigeria, the major problem associated with meat is the storage and preservation of its products. The method of preservation is a major challenge among meat handlers, entreprenuers and consumers. Over the years, studies had been made in relation to the method of meat preservation, the low level of scientific and technological input in processing,packaging, storage (where necessary), preservation and methods of distribution of these dried meat products, are responsible for lack of uniformity in their organoleptic qualities [11].

Meat can be kept edible for a much longer time, though not indefinitely, if proper hygiene is observed during processing, and if appropriate food safety, food preservation and food storage procedures are adequately followed [13,14]. Meat floss is a popular indigenous meat product that enjoys wide acceptability among the locals and tourists in Nigeria and some neibouring west and central African countries [5,15,16]. This study was therefore undertaken to investigate the effects of storage media on the quality of meat floss ‘‘*dambun nana’’* processed from white meat.

Materials and Methods

Experimental site

The study was carried out at the Department of Animal Science, Ahmadu Bello University, Zaria, Nigeria. It is on the coordinates $11^0 20^{'}$N and $7^0 45^{`}$E, at an altitude of 610m above sea level [17].The climate is relatively dry, with mean annual rainfall ranging from 700 to 1400 mm and occurring between the months of April and October. The dry season begins around the middle of October, with cold weather that ends in February. This is followed by relatively hot, dry weather from March to sometime in middle April, when the rains begin. The mean minimum and maximum daily temperatures are 14^oC and 24^oC, respectively during cool season and 19^oC and 36^oC during the hot season, respectively. Relative humidity varies between 19 and 35% in the dry season, and between 63 and 80% in the rainy season [17].

Analysis for chemical composition

The meat samples were taken immediately to the laboratory for analysis of gross composition. Proximate analysis was done on the various meat sample used. The moisture content, crude protein, crude fat, crude fibre and ash content were determined using [18] (Table 1).

Table 1: Proximate composition (%) of fresh meat samples from white meat

White meat	Moisture	Crude protein	Ash	Nitrogen free extract	Fat
Local chicken	8.53	48.38	2.47	42.63	6.52
Turkey	8.94	47.94	2.54	43.95	5.57
Guinea fowl	9.33	48.81	2.89	42.19	6.13
Fish	7.08	52.06	3.96	37.94	6.04
Duck	8.03	47.56	4.32	42.13	5.99

Processing of dambun nama

Three (3) kg each of the white meat from mature local chicken, local turkey, local duck, guinea fowl and fish was used. Each of the samples was trimmed, and the connective tissues and visisle fats were removed. All samples were cooked for 60 minutes at a temperature of 105^oC under the same condition with the same amount of ingredients and were fried for 30 minutes using stainless steel frying pan. The cooked soft meat was separated from the bones and remnant of fats. It was then pounded thoroughly and the matrix was separated manually. The separated matrix was then fried until when the meat was golden brown which lasted for 30 minutes. After it was then cooled and packaged in plastic containers from where samples were drawn for subsequent sensory evaluation.

Sensory evaluation of dambun nama

The organoleptic quality assessment of the four *dambun nama* samples processed from the five white meat types were evaluated using 9 point hedonic scale; where 9 - like extremely, 8 - like very much, 7 - like moderately, 6 - like slightly, 5 - neither like nor dislike, 4 - dislike slightly, 3 - dislike moderately, 2 - dislike very much and 1 - dislike extremely [19]. The evaluation was based on colour, taste, flavour, acceptability, aroma, tenderness and appearance. A total of 36 trained penalists/sensory judges, comprising both academic staff and postgraduate students familiar with quality attributes of meat products were constituted at the Department of Animal Science, Ahmadu Bello University, Zaria, for sensory evaluation, as per the methods described by [19].

Microbial analyses

The *dambun nama* processed from the five white meat was each stored using two storage media (glassware and stainless steel containers). These samples were prepared for microbial analyses using the two storage media under the same temperature condition, and the formation of microorganism was counted sequentially, both for bacteria and fungi, as per the methods of [18].

Ten grams of each representative sample was weighed aseptically using a sterile forceps into a conical flask containing 0.1% sterile peptone water. The contents were shaken thoroughly to allow dispersion of organisms on the sample, with pre-sterile pipette, serial dilution were done serially to 10^{-3}, from each of 10^{-3} dilution 0.1ml of the dilution was aseptically into sterilized plate count agar and potato dextrose argar plates respectively in duplicates, a bend glass rod (spreader) was used to spread the inocula on the surface of the culture media. All inoculated plate count agar for bacteria were incubated at 37 ^{o}C for 18-24 hours, while the potato dextrose agar plates for the examination of fungi (yeasts and moulds) were incubated at 25 - 27 ^{o}C for 5 days.At the end of incubation period the bacterial and fungal colonies were counted and average taken. The counts were now expressed as colony forming unit per gram (cfu/g) [18].

cfu/g = (Total Number of Colonies Counted × Dilution factor)/Volume of inocula

Data analysis

All data collected from the microbial counts were subjected to analysis of variance (ANOVA) using [20] procedure. Mean treatments that showed significant differences were separated using the Duncan's Multiple Range Test.

Results

The data on sensory quality of *dambun nama* processed from white meat are presented in Tables 2 to 5. The results showed that there were significant (P<0.05) differences among the white meat type with respect to taste, appearance, tenderness, colour and acceptability. The results also revealed that flavour and aroma did not differ significantly across the meat types (Table 2).

Table 3 shows data on sensory attributes of *dambun nama* as influenced by academic staff panellists. The results showed that taste, flavour, appearance, tenderness, aroma, and acceptability were significantly (P<0.05) different across the five white meat investigated (local chicken, turkey, guinea fowl, duck and fish). However, the colour of *dambun nama* from the five meat types did not differ significantly, as depicted in Table 3.

Table 2: Sensory properties of *dambun nama* from white meat as influenced by postgraduate student panellists

Parameters	Local chicken	Turkey	Guinea fowl	Fish	Duck	SEM	LOS
Taste	7.88^{a}	7.65^{ab}	7.48^{ab}	7.16^{ab}	6.72^{b}	0.52	*
Flavour	7.54	7.16	7.64	6.88	6.84	0.55	NS
Appearance	7.89^{a}	7.44^{ab}	7.28^{ab}	7.00^{ab}	6.60^{b}	0.58	*
Tenderness	7.80^{a}	7.36^{ab}	6.88^{abc}	6.44^{bc}	6.04^{c}	0.57	*
Colour	7.69^{a}	7.12^{ab}	7.04^{ab}	6.96^{ab}	6.40^{b}	0.56	*
Aroma	7.46	6.96	6.96	6.96	6.96	0.62	NS
Acceptability	7.52^{a}	7.35^{a}	7.32^{a}	7.08^{a}	6.32^{b}	0.67	*

$^{a-d}$, Means across rows with different superscripts differed significantly at (P<0.05), NS = Not significant at P < 0.05. SEM = Standard errors of mean, LOS = Level of significance

Table 3: Sensory properties of *dambun nama* from white meat as influenced by academic staff panellists

Parameters	Local chicken	Turkey	Guinea fowl	Fish	Duck	SEM	LOS
Taste	7.20^{a}	6.80^{b}	6.70^{b}	6.30^{b}	5.60^{b}	0.60	*
Flavour	7.80^{a}	7.00^{ab}	6.40^{bc}	6.30^{bc}	5.80^{c}	0.58	*
Appearance	7.70^{a}	7.40^{ab}	7.20^{abc}	6.10^{bc}	6.00^{c}	0.52	*
Tenderness	7.20^{a}	7.50^{a}	6.20^{a}	7.30^{b}	6.00^{c}	0.54	*
Colour	7.20	6.80	6.30	6.20	6.20	0.72	NS
Aroma	7.70^{a}	6.70^{ab}	6.40^{ab}	6.10^{b}	5.90^{b}	0.74	*
Acceptability	7.90^{a}	7.70^{a}	7.50^{ab}	6.80^{bc}	6.50^{c}	0.42	*

$^{a-d}$, Means across rows with different superscripts differed significantly($P<0.05$). NS= Not significant at $P<0.05$, SEM = Standard errors of mean, LOS = Level of significance.

Table 4 shows the overall results on sensory attributes of *dambun nama* as influenced by the pooled data of academic staff and postgraduate student panellists. The results showed that appearance, aroma, flavour, acceptability, tenderness and colour differed ($P<0.05$) significantly across the five meat types considered in the studied. The results also showed that taste attribute was not significantly different across these meat types, as shown in Table 4.

Table 5 shows the correlation matrix of sensory attiributes for the pooled data. There were many significant and positive correlations among the attributes studied. For instance, correlations between appearance vs colour ($r = 0.66$) ($P<0.05$) while the least correlation was between tenderness vs acceptability ($r = 0.24$) ($P<0.05$). There were also medium correlation between tenderness vs colour ($r = 0.30$) ($P<0.05$), tenderness vs acceptability ($r = 0.24$) ($P<0.05$) and tenderness vs acceptability ($r = 0.24$) ($P<0.05$), as presented in Table 5.

Table 4: Overall sensory properties of *dambun nama* processed from white meat

Parameters	Local chicken	Turkey	Guinea fowl	Fish	Duck	SEM	LOS
Taste	7.42	7.36	7.28	6.78	6.75	0.60	NS
Appearance	7.64^{a}	7.22^{ab}	7.11^{ab}	6.83^{b}	6.53^{b}	0.59	*
Aroma	7.19^{a}	7.02^{ab}	6.92^{a}	6.81^{a}	6.69^{a}	0.51	*
Flavour	7.33^{a}	7.06^{ab}	6.92^{ab}	6.81^{ab}	6.50^{b}	0.57	*
Acceptability	7.56^{a}	7.59^{ab}	7.08^{ab}	7.00^{ab}	6.69^{b}	0.62	*
Tenderness	7.77^{a}	7.39^{ab}	6.97^{bc}	6.36^{cd}	6.03^{d}	0.54	*
Colour	7.55^{a}	6.94^{ab}	6.83^{ab}	6.81^{ab}	6.36^{b}	0.60	*

$^{a-d}$ Means across rows having different superscripts differed significantly($P<0.05$). NS = Not significant at $P<0.05$, SEM = Standard errors of mean, LOS = Level of significance

Table 5: Correlation matrix of sensory attributes of *dambun nama* processed from white meat

Parameters	1	2	3	4	5	6	7
1. Taste	_						
2. Flavour	0.60**	_					
3. Appearance	0.63**	0.62**	_				
4. Tenderness	0.61**	0.51**	0.50**	_			
5. Colour	0.49**	0.49**	0.66**	0.30*	_		
6. Aroma	0.55**	0.56**	0.52**	0.42**	0.53**	_	
7. Acceptability	0.48**	0.39**	0.49**	0.24*	0.55**	0.62**	_

*P<0.05; **P<0.01

Table 6: Effects of storage on total fungal counts (cfu/g×10^4) of *dambun nama* processed from white meat

White meat	Week of Storage					LOS
	1	2	3	4	5	
Local chicken	1.5^a	2.0^a	4.5^b	4.5^b	7.5^c	*
Turkey	1.5^a	1.5^a	4.5^b	9.3^c	14.5^d	*
Guinea fowl	4.4^a	5.5^a	10.4^b	14.3^c	15.5^c	*
Fish	2.5^a	3.5^a	6.1^b	9.5^c	14.4^d	*
Duck	1.5^a	1.5^a	2.0^b	3.5^c	4.0^c	*

$^{a-d}$ Means across rows with different superscripts differ significantly(P<0.05), LOS = Level of significance

Table 7: Effects of storage period on bacterial counts (cfu/g×10^4) of *dambun nama* processed from white meat

White meat	Week of Storage					LOS
	1	2	3	4	5	
Local chicken	6.3^a	8.5^{ab}	8.6^{ab}	8.9^{ab}	10.5^b	*
Turkey	4.0^a	8.5^b	12.0^c	15.0^c	17.4^d	*
Guinea fowl	8.0^a	8.6^{ab}	10.5^{ab}	13.4^b	15.4^b	*
Fish	7.5^a	7.6^{ab}	9.5^b	9.5^b	11.5^{bc}	*
Duck	3.0^a	4.1^a	8.7^b	10.0^{bc}	12.5^c	*

$^{a-d}$ Means across rows with different superscripts differed significantly(P<0.05), LOS = Level of significance

Data on the quality of *dambun nama* stored in glassware and stainless steel containers are presented in Tables 6 to 9.The results showed that there were significant (P<0.05) differences in the storage of *dambun nama* from the white meat studied.

The quality of the product (*dambun nama*) deteriorated with the increase in storage period. *Dambun nama* stored at lower weeks (1st and 2nd weeks) are better than those kept at week 4 and 5. However, *dambun nama* from guinea fowl and turkey meat deteriorated faster than the other white meat (fish, local chicken and duck) in terms of the total fungal and bacterial counts, as shown in Tables 6 and 7.

Table 8 depicts data on total microbial counts (bacteria and fungi) of *dambun nama* from the five white meat types. The results showed significant ((P<0.05) differences in quality and rate of deterioration of the product as storage progressed over a 5-week period. The decline in quality (highest total counts) of the product was fastest in guinea fowl, followed by fish and turkey. Similarly, *dambun nama* from other white meat (local chicken and duck) deteriorated slowly as the product stored up to 5-week period, as depicted in Table 8.

However, at 5th week of storage *dambun nama* from duck meat had the lowest total microbes of 16.5 x 10^4cfu/g and followed by local chicken with 18.0 x 10^4cfu/g. Furthermore, the results showed that *dambun nama* from turkey meat had the highest microbial load of 31.9 x10^4cfu/g, followed by guinea fowl meat (30.9 x10^4cfu/g) and fish (25.9 x 10^4cfu/g) at 5-week storage (Table 8).

Table 8: Effects of storage period on total counts (cfu/g×10^4) of *dambun nama* from white meat

White meat	Week of storage					LOS	
	1	2	3	4	5		
Local chicken	7.8^{a}	10.5^{a}	13.1^{ab}	13.4^{ab}	18.0^{c}	*	
Turkey	5.5^{a}	10.0^{b}	16.5^{c}	24.3^{d}	31.9^{e}	*	
Guinea fowl	12.4^{a}	14.1^{ab}	20.9^{bc}	27.7^{d}	30.9^{d}	*	
Fish	10.0^{a}	11.1^{a}	15.6^{b}	19.0^{bc}	25.9^{d}	*	
Duck	4.5^{a}	5.6^{a}	10.7^{b}	13.5^{bc}	16.5^{bc}	*	

$^{a-e}$Means across rows with different superscripts differed significantly (P<0.05), LOS = Level of significance

Table 9: Effects of packaging media on total microbial counts (cfu/g×10^4) of *dambun nama*

Packaging media	Week of Storage				
	1	2	3	4	5
Fungal counts					
Stainless steel	21.3	20.5	16.8	11.0	9.0
Glassware	29.6	17.2	16.9	14.5	8.7
LOS	*	*	*	*	*
Bacterial counts					
Stainless steel	26.1	20.5	20.1	14.1	13.7
Glassware	36.3	30.5	21.2	20.3	17.2
LOS	*	*	*	*	*
Total counts					
Stainless steel	47.4	40.0	36.9	25.1	22.7
Glassware	65.9	47.7	38.1	34.8	25.9
LOS	*	*	*	*	*

Means in each column within a subset differ significantly (P<0.05), LOS = Level of significance

Table 9 presents data on total microbial load of *dambun nama* stored in the two storage media (stainless steel and glassware containers). The results also revealed significant ($P<0.05$) differences at all the five storage weeks. The stainless steel container had the lowest counts in terms of both the fungal and bacterial counts at different weeks of storage than when *dambun nama* was stored in glassware medium, as shown in Table 9.

Discussion

The significant differences observed among the two categories of panellists (academic staff and postgraduate students) with respect to the observed differences in the sensory attributes of *dambun nama* processed from five types of white meat (local chicken, turkey, guinea fowl, duck and fish). This difference is an indication that there is marked variation in the consumers' preferences of these *dambun nama*. This variation might have been attributed to differences in the socio-cultural background of these panellists. For instance, the panellists belonged to different ethnic groups and geographical locations since *dambun nama* is a meat product that is well-cherished and enjoy wide acceptability in the Northern Nigeria, where it has been in existence for donkey years [17]. These differences were similarly reported using five different types of suya processed from pork, beef, chicken, rabbit and goat meat [21]. These preferences were reported using a combination of white meat (broiler chicken) and red meat (beef, mutton, chevon and camel meat) [4].

However, *dambun nama* processed from local chicken and turkey meat were superior in terms of tenderness and acceptability, as compared to other white meat (duck, guinea fowl and fish) studied. This attribute (tenderness) is one of the primary factors influencing consumer satisfaction. For instance, the tenderness of fat in meat is considered one of the decisive factors influencing the sensory quality of meat, particularly where there are significant differences between the samples being evaluated [22]. The differences in meat colour and tenderness might have been due to differences in the marbling of meat samples [4]. Also, this difference in meat colour may be associated to differences in the myoglobin contents in their muscles and meat [4]. Meat colour has a powerful influence on consumer acceptance of food products especially meat products, and serves as a visual indicator of meat quality [23]. This was similarly reported by [24] that traditionally, meat colour has been the main criterion for evaluating freshness of retail meat which is a key component of consumer purchase decision of retail beef.

Furthermore, the good aroma scores for *dambun nama* from local chicken (7.19) and turkey (7.02) have been obtained in the combined results of panellists (academic staff and postgraduate students), which may be linked to varied cultural background and familiarity of these white meat. Aroma is made up varieties of different classes of chemicals that are in either present in the final ingredients or are formed during processing [25]. Flavour which is linked to aroma has been defined as the combined perception of taste, smell and mouth feel [25].

The high overall acceptability values for *dambun nama* from different types of white meat; local chicken (7.56), turkey (7.59), guinea fowl (7.08), fish (7.00) and duck (6.69) were exhibited in the present study. The superiority of the local chicken over other types of white meat in most of these sensory attributes may not be unconnected with the aroma generally associated with the local chicken meat which most panellists are familiar with and can easily identify the meat. This was similarly reported by [4,5] that familiarity of a product has positive influence on its acceptability. For example, [4] reported higher acceptability scores of *dambun nama*

processed from broiler chicken (7.62±0.25), and chevon (7.65±0.26) than in other red meat types; beef(7.14±0.30), mutton (7.14±0.31) and camel meat (7.57±0.25). Type of meat is a primary motivator for consumer acceptance [26].

However, the significant and high positive correlations among the sensory attributes of the five types of white meat investigated. These attributes (taste, flavour, appearance, tenderness, colour, aroma and acceptability) can largely be used to improve quality of meat and meat products among panellists especially of diverse cultural background. These high significant correlations were similarly reported by [4]. The significance of correlating these attributes cannot be overemphasized. The acceptance of a meat product can be improved through improvement of its colour which attaches great significance to consumers [4]. These strong relationships of these meat attributes are a positive indication that a low quality meat product with a low acceptance value can be improved through artificial manipulation of consumption and overall acceptability, as observed by [4].

Several chemical factors are said to be involved in the stability of meat products. But the chief concern for product stability is the control of microbial growth. The moisture content of any meat product plays a significant role in the shelf-life and stability. With higher moisture content, the micro-organisms are given enabling environment for growth and multilpications [12]. The significant differences obtained in the present study is an indication of the differences in the moisture contents among the different types of white meat investigated, and the subsequent action of microbes on the stored-meat products. For instance, *dambun nama* from local chicken and duck meat stored better with lowest total counts of both bacterial and fungal growth, as compared with other types of white meat (turkey, guinea fowl and fish). This might have been attributed to the differences in the total microbial loads of the stored meat products. Fish is one of the most perishable staples; it spoils very quickly because of intrinsic and extrinsic factors. The high ambient temperature in the tropics hastens the spoilage of fish and other meat products by accelerating the activities of bacteria, enzymes and chemical oxidation of fat in fresh fish [7]. For meat products to be stabled especially in the tropics, the rate of microbial growth must be controlled substantially. This control can be achieved by lowering the moisture contents of the meat products to critical level thus inhibiting microbial growth and multiplications. The moisture content of meat must be lowered to below 50% on wet basis before protection is afforded against microorganisms [27]. The microbial load on the product may be kept low if only good hygiene practices are followed at all stages of processing and handling [12].

Meat can be kept edible for a much longer time; though not indefinitely, if proper hygiene is observed during production and processing, and if appropriate food safety, food preservation and food storage procedures are adequately followed [13,14]. Meat is considered as an important source of proteins, essential amino acids, B complex vitamins and minerals which offer favorable environment for the growth of pathogenic bacteria. The microbiological contamination of carcasses occurs mainly during processing and manipulation, such as skinning, evisceration, storage and distribution at slaughter houses and retail establishments [28].

The present investigation revealed that as the storage period of *dambun nama* increases from 1st to 5th week the action of micro-organisms increases to rapidly lower the quality of the various meat products. This means that there was increase in both the total fungal and bacterial loads on the various meat samples.

This was similarly reported by [29]. This study revealed that the shelf-life was about 35 days, which agrees with the findings of [16] reported a range of 3 to 83 days when there is low presence of oxygen in the product. The shelf-life of vacuum-packaged fresh beef was generally reported as approximately 35 to 45 days, reported by [30, 31].

The significant ($P<0.05$) differences observed among the microbial counts of *dambun nama* after storage are probably due to the effect of the packaging media of the processed meat products. The packaging effect might have been one of many reasons why the packaged product does not adequately receive enough heat to prevent further microbial decay.The main factors having the greatest influence on the growth of microorganisms in meat and meat products are the storage temperatures, moisture and oxygen availability [11]. However, the stainless steel packaging medium was effective in controlling the growth and multiplication of microbes in the meat samples as compared to the the glassware storage container. Stainless steel containers have been known to play a positive role in increasing the shelf life of products due to its inherent physical and metallic properties.

Conclusions and Applications

This study concludes as follows:-

1. Sensory panellists showed more preference towards *dambun nama* processed from turkey and local chicken meat than other white meat types.
2. The less preferred *dambun nama* from other white meat can be greatly improved through artificilal manipulations of the sensory attributes that have strong relationships.
3. Inherent variation existed in the shelf-life of *dambun nama* processed using different types of white meat.
4. Storage of *dambun nama* in stainless steel containers had better and longer shelf life than using other media such as glassware containers.

References

1. Olaoye, O. A. and Onilude, A. A. (2010). Investigation on the potential use of biological agents in the extension of fresh beef in Nigeria. *World Journal of Microbiology and Biotechnology*, 26: 1445–1454, DOI: 10.1007/s11274-010-0319-5.
2. Akpata, D. F. and Ojo, Y. (2000). Efficacy of the Trichodermaviride enzyme complex in broiler starter fed cowpea testa based diets. *Procedings of 25th Annual Conference of Nigerian Society for Animal Production* . March 19-23 2000, 132-134.
3. Musa, R. S. (2016). Sensory quality and shelf life of fried minced meat (*dambun nama*) processed from various animal species. Unpublished B. Agric Project, Department of Animal Science, Ahmadu Bello University, Zaria, pp56.
4. Balarabe, S. (2016). Chemical composition and sensory evaluation of *dambun nama* (fried minced meat) processed from different animal species. Unpublished M Sc thesis, Department of Animal Production, Abubakar Tafawa Balewa University, Bauchi, Nigeria, Pp81.
5. Kalla, D. J. U., Zahraddeen, D., Abubakar, M., Oladotun, F. B. and Jibia, S. D. (2005). Influence of species and processing methods on red meat acceptance among panelists of variouscultural background in Bauchi. *Journal of Agriculture, Business and Technology*,3 (2):51-57.
6. Ikani, E. I. and Dafwang, I. I. (2004). The production of guinea fowl in Nigeria. *Poultry Series*, 8(8):1-37.

7. Ayo, J. A.(2001). The effect of amaranth grain flour on thequality of bread. *International Journal of Food Properties, 4: 341-351.*
8. Egena, S. S. A. and Ocheme, O. B. (2008). Effects of hydrocyanic acid intake on sensory properties of broilers meat. *Pakistan Journal of Nitrogen* 1:191 -193 ISSN 1680.
9. Hashim, I. B., Resurreccion, A. V. A., Mcwaiters, K. H. (1995). Descriptive sensory analysis of irradiated frozen or refrigerated chicken. *Journal of Food Science,* 60: 664-666.
10. Saha, A., Perumall, A. V., Lee, Y., Meullenet, J. F. and Owens, C. M. (2009). Tenderness, moistness, and flavor of pre- and postrigor marinated broiler breast fillets evaluated by consumer sensory panel. *In: Poultry Science,* 88:1250-1256.
11. Forrest, J. C., Aberie, D. E., Gerard, Mills, W. E., Hedrick, H. B., Judge, M. D. and Merke, R. A. (2001). The Principles of Meat Science, 4th Edition, Kendall/Hunt Publishing Company, USA.
12. Balarabe, S., Doma, U. D., Kalla, D. J. U. and Zahraddeen, D. (2016a). Animal products and handling: A caution for consumers and entrepreneurs. *Nigerian Journal of Animal Science,* 18(1): 266 - 274.
13. Odusole, K. A. and Akinyanju, O. O. (2003). Red *suya* syndrome-acute intravascular administration and control. *Consumer Safety Bulletin,* 2(2): 20-24.
14. Inyang, C. U., Inyor, M. A., Uma, E. N. (2005). Bacteriological quality of a smoked meat product (suya). *Nigerian Food Journal*, 23: 239-242.
15. Zahraddeen, D., Butswat, I. S. R. and Mbap, S. T. (2006). Preferences for goat meat and milk products consumption in Bauchi State, Nigeria. *Animal Production Research Advances*, 2 (1):6-11.
16. Balarabe, S., Doma, U. D., Kalla, D. J. U. and Zahraddeen, D. (2016b). Effects of two leaf extracts on sensory quality of minced meat (*Dambun Nama*) processed from various animal sources. *Nigerian Journal of Animal Science,* 18 (2): 572-582.
17. IAR (2015). Institute for Agricultural Research, Metrological Station. Samaru weather report, Samaru office, Ahmadu Bello University, Zaria.
18. AOAC (1995). Official Methods of Analysis. Association of Official Analytical Chemist, Washington DC, 15 (1), p931-946.
19. Bube, M. M. (2003). Nutritional evaluation of meat from various animal species processed by different methods. Unpublished PhD thesis, Animal Production Programme, Abubakar Tafawa Balewa University, Bauchi, pp89.
20. SAS (2002). Statistical Analysis Institute. Users Guide, version 9 Edition, SAS Institute Inc. Calorina, USA.
21. Ojewola, G. S. and Onwuka, G. I. (2001). Evaluation of the organoleptic properties of *suya* produced from various sources of meat. *Nigerian Journal of Animal Production*, 28 (2)**:**199-201.
22. Hocquette, J. F., Gondret, F., Baeza, A., Medale, F., Jurie, C. and Pethick, D. W. (2010). Intramuscular fat content in meat producing animals: Development, genetic and nutritional control and identification of putative markers. *Animals*, 4: 303-319.
23. James, G. (1993). Packaging, storage and delivery of ingredients. *Journal of Food Technology*, 47 (8):54-63.
24. Wheeler, T. I., Koohmaraie, M. and Crouse, J. D. (1991). Effects of calcium chloride injection and hot-boning on the tenderness of round muscle. *Journal of Animal Science,* 69 (12): 4511-4875.
25. Leora, C. H. (1994). Overcoming flavour challenges in low fat frozen deserts.

Journal of Food Technology, 48 (2): 98-105.

26. Radovanovic, R., Cavoski, D., Peric, V., Bojoric, F., Dumic, S. and Stanojevic, S. (1991). Result of study of consumer options on quality consumption and types of meat and meat products in Balgrade market. *Journal of Food Technology,* 45 (2): 69-73.
27. Hedrick, H. B., E. D. Aberle, E. D.,Forrest, J. C., Judge, M. D. and Merkel, R. A. (1994). Properties of fresh meat. *In*; H. B., Hedrick, E. D., Aberle, J. C. Forrest, M. D. Judge and R. A. Merkel (eds), *Principle of meat Science. I.A.Dubuque,Kendall/Hunt Publishing Company,* pp123-131.
28. Abdullahi, I. O., Umoh, V. J. and Galadima, M. (2004). Hazards associated with kilishi preparation in Zaria, Nigeria. *Nigerian Journal of Microbiology* 18 (1-2): 338-345.
29. Luno, M., Roncales, P., Djenane, D. and Beltrán, J. A. (2000). Beef shelf life in low O_2 and high CO_2 atmosphere containing different low CO_2 concentrations. *Meat Science, 55: 413-419.*
30. Alonge, D. O. and Hiko, A. A. (1987). Traditional Methods of Meat Preservative and Preparation in Nigeria. *West African Farming and Food Processing, March/April No. 19*
31. Fakolade, P. O. and Omojola, A. B. (2008). Proximate composition, pH value and Microbiological evaluation ‘‘Kundi” (dried meat) product from beef and camel meat.*Conference on International Research on Food Security, Natural Resource Managemnet and Rural Development. University of Hohenheim, Tropentag.p3.*