QUALITY ASSESSMENTS OF DEHYDRATED BEEF AND FROZEN BEEF DURING STORAGE

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ABSTRACT

A smoking kiln dehydrated beef and frozen beef were studied for the effect of storage on their physicochemical qualities. Parameters such as pH, titratable acidity, water absorption capacity, as well as proximate compositions were analysed using standard methods for a period of 16 weeks. Data collected were analysed using analysis of variance and treatment means were compared using Turkey test at 5% probability level. Significant ($p<0.05$) differences were observed in the physical and nutritional parameters between the frozen and dehydrated beef in storage durations. The pH ranged between 4.51-4.55 and 6.39-6.65 for dried and frozen beef respectively during the storage period. During the storage period, there were slight decline in the proximate parameters for both dried and frozen beef. However, the rate of decline was more significant in moisture and fat contents of frozen beef than dehydrated beef. While dried beef had significantly ($p<0.05$) higher values in terms of crude protein, crude fibre and ash contents, the highest proximate parameter recorded being protein ranged between (68.76±2.20 to 68.61±1.99) % for dried beef and between (10.99±1.06 to 10.07±0.11) % for frozen beef throughout the period of storage. This study revealed that dehydration method provided more retention of physicochemical properties for beef storage than freezing method.

Keywords: Quality, Dehydrated, frozen, Beef, Storage.

INTRODUCTION

Beef is a type of meat gotten from cow or bull which is mainly consumed when thermally processed for its nutritional values especially amino acids, fatty acids and micronutrient (Mahindra and Modular, 2018). Just like other perishable food products, meat is susceptible to natural and mostly irreversible physical, chemical, biochemical and microbiological changes that may deteriorate its functional and sensory properties. Beef or any other type of meat is commonly stored fresh in the refrigerator or freezer to extend its shelf life (Laygonie *et al.* 2012,).

Beef as a perishable food product is commonly preserved in its fresh form through freezing which is a method that greatly minimize microbial infestation (Rajendran et al., 2020). During freezing, not only microbial, but also, enzymatic activities as well as fat oxidation are retarded, thus limiting the possibilities of spoilage (Rajendran et al., 2020). However, due to freezing temperature, quality deterioration such as discoloration, reduce water holding capacity and poor texture have pose economic losses in meat industries (Laygonie *et al.*, 2012). Dehydration as a method of preservation decrease the moisture content of meat sample and as such extend it shelf-life (Wang et al., 2016). The process of dehydration of meat is associated with physical changes in colour and the level of water and fat contents dropping off the meat sample thus concentrating the nutritional parameters (Wang, et al., 2021). Unlike fresh meat, dried meat is shelf stable due to low moisture and fat contents (Gao, *et al.*, 2020; FAO, 2007). This study, therefore, is to investigate the changes in some physicochemical properties of dehydrated and frozen beef during storage.

MATERIALS AND METHODS

Sample Collection and Preparations

A life male cow commonly referred to as bull was purchased, allowed to rest for 24 hours and then sacrificed. After being butchered into desirable sizes, 100 pieces of equal weight of about 50g of the fresh meat devoid of physical fatty layers were taken. Fifty percent of the meat pieces were dehydrated using NSPRI-smoking kiln while the remainder was packaged in five pieces each in a 10 separate polyethene bags and stored for a period of four months in a freezer between -12 to -23°C. The dried beef samples were packaged in ten different zip-locked laminated paper envelopes.

Proximate Analysis

Proximate composition was determined on monthly basis on each of frozen and dehydrated meat to estimate in percentages of moisture content, crude fiber, ash, protein fat and nitrogen free extracts (NFE) according to method of analysis as described in AOAC 2019 reversed edition.

pH and Titratable Acidity Determination

pH was measured in water homogenates (1:1 m/v) ration of meat to distilled water using a Milwaukee pH Meter coupled with a temperature probe in accordance with AOAC (2019) while Titratable acidity level were measured according to method described in AOAC (2019). Water holding capacity was determined in accordance with the gravimetric methods described by Onwuka (2005) and Lan *et al.* (2016).

RESULTS AND DISCUSSION

The shelf-life studies of dehydrated beef and that of fresh beef stored in laminated paper envelopes and in freezer respectively have been investigated by some physicochemical parameters withing a period of four months. In table 1.0, there were significant differences in pH, titratable acidity and the proximate compositions of fresh, smoking kiln dried and frozen beef. pH was highest (6.39) and lowest (4.51) in frozen and dried beef respectively. Fat content were significantly low for frozen beef compared to that of fresh. This could be attributed to the difference in polarity of water and oil and post thawing effect (Lan et al.,2016). High water absorption capacity of dried beef throughout the storage time as shown in table 2.0 could be attributed to lower fat and immobilized water content interfacing the dried beef muscles (Zhang, et al., 2005). During storage period, significant ($p<0.05$) increase in the level of pH (from 6.39 to 6.65) observed with frozen beef could be due to the breakdown of amino acids of protein (Akram et al., 2019). Table 3.0 showed slight decline in proximate parameters for both dried and frozen beef except for moisture content which was on increasing trend for the dried beef during the storage period. Meanwhile, protein content of frozen beef is significantly($p<0.05$) lower relative to that of dried beef which remained the highest proximate parameter (between 68.76±2.20 to 68.61±1.99) % recorded throughout the period of storage. The freezing effect on protein content could be attributed to structural damage of muscle tissues as a result of ice crystal formation and water loss due to thawing (Laygonie, 2012). Frozen beef is only higher in contents of fat, moisture and nitrogen free extract than the dried beef which has more crude fiber, crude protein and ash contents during the period of storage.

Table 1.0: Physico-chemical composition of Fresh, Dried and Frozen Beef in the Zeroth Month

	Form of Meat		
	Fresh	**SKD**	**Frozen**
Physical Appearance	Bright-Red	Caramelized	Brownish-red
pH	5.28	4.51	6.39
Water Absorption Capacity (%)	NA	125.20	NA
Titratable Acidity	2.30	1.05	2.06
Moisture	75.12	4.98	56.99
Crude Fiber	1.53	3.82	1.50
Crude Protein	13.26	68.76	10.99
Ash	2.05	6.03	5.56
Fat	4.52	1.53	3.81
NFE	3.52	14.88	21.15

WAC = Water Absorption Capacity expressed in percentage equivalent to ml/100g sample
NFE = Nitrogen Free Extract, SKD = Smoking Kiln Dried, NA= Not Available (not measured).

Table 2.0: Some Physico-chemical Characteristics of Frozen and Dehydrated Beef in Storage

Parameters	Treatment	Storage Period (Weeks)				
		0	IV	VIII	XII	XVI

pH	Frozen	6.39	6.55	6.59	6.61	6.65
	SKD	4.51	4.51	4.51	4.51	4.52
WAC	Frozen	NA	NA	NA	NA	NA
	SKD	125.20	125.20	125.20	125.05	125.05
TTA	Frozen	2.06	2.00	2.00	1.78	1.55
	SKD	1.05	1.05	1.05	1.02	1.00

Results are means ± SD of triplicate experiments. Mean values in same row with same superscripts are not significantly ($p \geq 0.05$) different. SKD =Smoking Kiln Dried Meat, WAC= Water Absorption Capacity., TTA= Titratable Acidity., NA= Not Available.

Table 3.0: Proximate Compositions of Frozen and Dehydrated Beef in Storage

Parameters	Treatment	Storage Period (Weeks)				
		0	IV	VIII	XII	XVI
Moisture	Frozen	56.99 ± 2.01^{a}	56.08 ± 0.01^{a}	55.98 ± 0.07^{a}	55.00 ± 1.03^{a}	49.52 ± 0.99^{b}
	SKD	4.98 ± 0.91^{b}	4.99 ± 1.01^{b}	5.03 ± 0.55^{c}	5.15 ± 0.11^{e}	5.19 ± 0.08^{f}
Crude	Frozen	1.50 ± 0.05^{a}	1.41 ± 0.25^{b}	1.39 ± 1.00^{c}	1.35 ± 0.08^{d}	1.30 ± 0.11^{e}
fiber	SKD	3.82 ± 0.50^{a}	3.81 ± 0.11^{c}	3.80 ± 0.55^{d}	3.65 ± 0.02^{g}	3.63 ± 0.50^{a}
Fat	Frozen	3.81 ± 0.10^{e}	3.77 ± 0.07^{f}	3.75 ± 0.02^{g}	3.65 ± 0.05^{h}	3.60 ± 0.99^{b}
	SKD	1.53 ± 0.01^{a}	1.50 ± 0.02^{s}	1.44 ± 0.55^{c}	1.40 ± 0.12^{d}	1.39 ± 0.50^{e}
Crude	Frozen	10.99 ± 1.06^{ac}	10.52 ± 1.05^{ab}	10.44 ± 1.00^{s}	10.24 ± 1.90^{af}	10.07 ± 0.11^{ae}
protein	SKD	68.76 ± 2.2^{a}	68.75 ± 1.05^{fd}	68.73 ± 0.02^{h}	68.65 ± 2.02^{ac}	68.61 ± 1.99^{af}
Ash	Frozen	5.56 ± 0.11^{a}	5.22 ± 0.01^{d}	5.09 ± 0.50^{ab}	4.88 ± 0.80^{ae}	4.82 ± 0.50^{ac}
	SKD	6.03 ± 0.91^{b}	6.03 ± 0.11^{h}	6.02 ± 0.05^{de}	6.02 ± 0.11^{ac}	6.02 ± 0.01^{de}
NFE	Frozen	21.15 ± 2.51^{e}	23.00 ± 2.00^{e}	23.35 ± 1.99^{f}	24.88 ± 2.00^{ab}	30.69 ± 2.05^{h}
	SKD	14.88 ± 1.63^{f}	14.92 ± 1.55^{b}	14.98 ± 1.55^{ac}	15.13 ± 1.55^{ah}	15.16 ± 1.03^{g}

Results are means± SD of triplicate experiments. Mean values in same column with different superscripts are significantly ($p \leq 0.05$) different. SKD =Smoking Kiln Dried Meat, NFE= Nitrogen free Extracts.

CONCLUSION AND RECOMMENDATIONS

Quality assessment studies of dehydrated beef stored in laminated envelopes and that of fresh beef stored in freezer were carried out for a period of four months. During the storage periods, qualities attributes in terms of crude protein, crude fibre and ash of beef were observed to be more retained in dehydrated beef than in frozen beef. It is therefore, recommended that beef which is essentially eaten for its protein source should rather be dried for long term storage than frozen for same storage time.

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