3:31 Some physical and chemical studies on drip resulted from frozen buffalo and camel meat

A.A. FAHMY AND S.A. EL-KADY*

Food Technology Department, Faculty of Agriculture, Kafr El-Sheikh, Tanta University, Egypt.
* Food Science Department, Faculty of Agriculture, Mansoura University, El-Mansoura, Egypt.

Introduction

The most obvious change occuring upon thawing frozen meat is the exuding of a blood-like fluid commonly called drip. Investigators have attributed drip losses to many factors, pH of meat (Ramsbottom and Koonz, 1940), storage temperature (Moran and Hale, 1932) and time of freezing post mortem (Rahelic et al., 1974). Pearson et al. (1959) found that the percentage of drip loss varied between 6.35 - 12.40%. Penny (1977), Dessouki et al. (1978) and Fahmy et al. (1981) found that the amount of drip loss increased continuously as the time of frozen storage increased which could be due to the increase of protein denaturation and aggregation as indicated by the decrease of total soluble nitrogen. Awad et al. (1968) found that the pH of the drip did not change with the storage period and ranged from 5.5 to 5.7 . According to Lawrie (1979) the solubilized nitrogenous compounds in the drip are sarcoplasmic proteins, creatine and creatinine, free amino acids, peptides, nitrogenous basis and their corresponding nucleosides and nucleotides, purine and pyrimidine degradation products, porphyrin containing compounds and metabolic cofactors. Fahmy et al. (1981) found that the moisture content of drip was 96.87% and 93.99% at the end of frozen storage (3 months). Ash was 1.04% and 1.29%, total nitrogen 1.30% and 1.85%, ether extract 0.40% and 0.65% and pH ranged between 6.50 - 6.82. The same authors found that the fatty acids composition of drip fat was markedly different when compared with intermuscular and subcutaneous fats. It was also noticed that short chain fatty acids ($C_{10} - C_{14}$) constituted the major portion of drip fat.

This study was carried out to throw more light on the changes of some physical properties and chemical composition of the obtained drip during thawing of frozen buffalo and camel meat samples.

Materials and Methods

Materials: Meat samples used in this investigation were obtained from the longissimus dorsi muscle of three years old male buffalo and camel meat. These samples were taken from the slaughter-house of Kafr El-Sheikh within two hours from slaughter. The samples were immediately brought to laboratory where fat and thick connective tissues were removed from the lean meat. Samples were cut into steaks of about 500 gm in weight, packed in polyethylene bags and stored at a freezing temperature of -20°C for 6 months. The separated liquid after thawing the frozen samples which is called drip was collected and analyzed physically and chemically.

Methods of analysis: (A) Physical analysis: 1) Drip loss: The drip loss of meat was determined according to the method described by Awad (1967). 2) Color intensity: The color intensity was determined according to the method described by Hussaini et al. (1950). (B) Chemical analysis: 1) Main chemical composition: Total solids, total nitrogen and ether extract contents were determined according to the method described by A.O.A.C. (1975). pH value of drip was measured by pH meter with glass electrode as described by Aitken et al. (1962). 2) Minerals: Minerals were determined in the digested acid solution as follows: calcium, copper, magnesium, manganese, iron and zinc were determined by using Pye Unicam SP 1900 Atomic Absorption Spectrophotometer at Faculty of Agriculture, Cairo University. Sodium and potassium were determined by the flame photometer. Total phosphorus was estimated colorimetrically according to the method described by Snell and Snell (1949). 3) Fatty acids composition: The fatty acids are converted to the methyl esters. This is because the latter are more volatile and do not show the high degree of association that the parent acids do. The methyl esters of fatty acids were prepared following the procedure adopted by Shehata et al. (1970). The esters were injected in gas liquid chromatography apparatus (Pye Unicam GCV Chromatograph) under the following conditions:

Flow rate of gases (Mobile phase): N_2 30 ml/min.
$N_2 + H_2$ 33 ml/min.
$N_2 + H_2$ + air 330 ml/min.
Column : PEGA. Column temperature: 190°C.
Detector: Flame ionization detector. Detector temperature: 220°C.
Injection temperature : 220°C. Chart speed : 2 min/cm.

The standard methyl esters fatty acids were subject to apparatus under the same conditions. Each fatty acid calculated as percentage of the total area of the peak.

Results and Discussion

(A) Physical properties: 1) Drip losses: The data presented in Table 1 show the amount of drip separated from buffalo and camel meat in the polyethylene bags as affected by frozen storage at -20°C for six months. It could be observed that samples lost increasing amounts of drip as storage time progressed , drip loss varied considerably according to type of meat. The drip amount (%) as proportion to the original value recorded after 1 month for the buffalo and camel meat were 153.80 and 169.50%, respectively, at the end of frozen storage period . The increase of the drip amount as the time of frozen storage increased could be ascribed to the development of both protein denaturation as indicated by the decrease of total soluble nitrogen and lipids oxidation, being in accordance with the decline of water holding capacity with advancing of storage time. It was reported that the temperature fluctuation during frozen storage enhanced the water migration from the cells , therefore the salt concentration increased inside the fibers causing more denaturation and insolubility of protein (Dyer and Dingle, 1967).

Table (1): The effect of frozen storage time at -20°C on the drip losses of buffalo and camel meat.

Samples	Storage time (months)					
	1	2	3	4	5	6
Buffalo	6.29	6.71	7.26	8.05	8.90	9.68
% retention	100.00	106.68	115.42	127.98	143.08	153.80
Camel	7.64	8.49	9.58	10.17	11.50	12.95
% retention	100.00	111.13	125.39	133.12	150.52	169.50

2) Drip color: The results presented in Table 2 show the effect of frozen storage time on the drip color intensity of buffalo and camel meat. It could be observed that the color intensity increased progressively as the time of frozen storage increased. Hence, it could be concluded that the loss of meat pigments (water soluble proteins) during thawing increased the color intensity of drip. The rate of drip color increase (as percent of value recorded after 1 month) was mostly greater for the camel meat than the buffalo meat indicating much greater losss of myoglobin in the separated drip.

Table (2): The color intensity (absorbance at 542 mμ) of drip of buffalo and camel meat as affected by frozen storage time at -20°C.

Samples	Storage time (months)					
	1	2	3	4	5	6
Buffalo	0.375	0.376	0.380	0.395	0.400	0.420
% retention	100.000	100.270	101.330	105.330	106.670	112.000
Camel	0.310	0.345	0.345	0.350	0.355	0.365
% retention	100.000	111.290	111.290	112.900	114.520	117.740

(B) Chemical analysis: 1) Main chemical composition (Total solids, total nitrogen, ether extract and pH value): The effect of frozen storage time of buffalo and camel meat on the main chemical composition is presented in Table 3.
Highest drip solids were found for buffalo meat than camel meat. It might be concluded that the drip of camel meat contained higher moisture and lower solids when compared with buffalo meat drip. In this connection the loss in nutrients with drip was lowest for the camel meat. It could be noticed that nitrogen content in the drip progressively increased with frozen storage time; nitrogen loss in drip followed closely the escape of solids. This could be explained on the basis that both tissue breakdown and total solids escape increased in the drip with advancing of storage age. The results presented here agreed well with the findings obtained by Choe (1980); Miller et al. (1980) and Fahmy et al. (1981). It could be also noticed that the ether extract increased as the time of storage increased. This increase may be ascribed to the increasing damage of tissues as the time of frozen storage increased. Similar results were found by Fahmy et al. (1981). From Table 3 also, it is evident that highest ether extract was found in the drip of buffalo than camel samples.

Table (3): The effect of frozen storage time at -20°C of buffalo and camel meat on the chemical composition of drip (as % of wet weight).

Storage time (months)	Total solids	Total nitrogen	Ether extract	pH value
		Buffalo		
1	9.50	2.10	1.67	5.90
% retention	100	100	100	100
2	10.75	2.12	1.69	5.90
% retention	113.16	100.95	101.20	100
3	11.16	2.14	1.86	5.95
% retention	117.47	101.90	111.38	100.85
4	11.68	2.26	1.90	6.00
% retention	122.95	107.62	113.77	101.69
5	12.00	2.35	1.98	6.05
% retention	126.32	111.90	118.56	102.54
6	12.70	2.40	2.17	6.10
% retention	133.68	114.29	129.94	103.39
		Camel		
1	7.70	1.81	1.45	6.25
% retention	100	100	100	100
2	7.74	1.82	1.47	6.20
% retention	100.52	100.55	101.38	99.20
3	7.98	1.86	1.71	6.25
% retention	103.64	102.76	117.93	100
4	8.55	1.89	1.87	6.30
% retention	111.04	104.42	128.97	100.80
5	8.72	1.90	1.93	6.30
% retention	113.25	104.97	132.41	100.80
6	10.56	2.32	2.00	6.35
% retention	137.14	128.18	137.93	101.60

It could be observed that the pH of the drip of buffalo and camel samples increased slightly, especially at the end of storage period. Such results indicates that deterioration of quality is not rapid in such frozen samples. The pH value of drip was higher for camel than buffalo samples. This was noticed at the given time of storage.

2) Minerals: Data in Table 4 show the minerals content of buffalo and camel meat drip as affected by the time of frozen storage at -20°C. It could be observed that for buffalo drip highest mineral concentration was recorded for K followed by P, then me Na; for camel meat drip highest concentration was recorded r K followed by Na, while the content of P was lower. he levels of minerals in drip were affected by the type of meat. t any given time of storage, Na and K concentrations in drip ere highest for camel, followed by buffalo meat samples, while was highest in the drip of buffalo samples than camel samples. he concentration of P, Cu and Zn were mostly highest in the drip f the buffalo meat, while for Ca the loss was highest for camel meat drip, Fe concentration in drip was more for buffalo. For the above mentioned minerals the given arrangement was noticed at any given time of storage, the case was not so far Mn. In conclusion, the concentration of minerals in drip was influenced by several factors such as the type of meat, time of storage and kind of mineral.

Table (4): The effect of storage time at -20°C on minerals content of drip of buffalo and camel meat (mg / 100 gm wet weight).

Minerals	Buffalo			Camel		
	Storage time(months)			Storage time(months)		
	1	3	6	1	3	6
Na	69	85	101	115	124	138
% retention	100.0	123.2	146.4	100.0	107.8	120.0
K	212	329	239	234	254	263
% retention	100.0	108.0	112.3	100.0	108.5	112.4
P	102	115	130	99	107	120
% retention	100.0	112.7	127.5	100.0	108.1	121.2
Ca	4.2	6.1	7.2	6.1	6.4	8.4
% retention	100.0	145.2	178.6	100.0	125.2	164.7
Fe	1.4	1.7	1.9	0.8	1.0	1.1
% retention	100.0	121.4	135.7	100.0	125.0	137.5
Cu	0.07	0.11	0.16	0.06	0.08	0.10
% retention	100.0	157.1	228.6	100.0	133.3	166.7
Mg	13.0	14.5	17.0	14.0	16.3	19.2
% retention	100.0	111.5	130.8	100.0	116.4	137.1
Mn	0.04	0.05	0.05	0.02	0.04	0.06
% retention	100.0	125.0	125.0	100.0	200.0	300.0
Zn	1.83	1.86	1.89	1.27	1.42	1.81
% retention	100.0	101.6	103.3	100.0	111.8	142.2

3) Fatty acids: Data presented in Table 5 show that the fatty acids composition of the lipids of the separated drip from buffalo and camel meat were largely affected by frozen storage period. Drip had more total saturated fatty acids and lower total unsaturated fatty acids than the respective meat and this could be noticed at any given period of storage except in the sixth month for the camel meat drip where the total unsaturated fatty acids were higher than the total saturated fatty acids. From Table 5, it was also noticed that $C_{18:0}$ constituted the major portion in the buffalo meat drip in the third and sixth months and the first and the third months of storage in the camel meat drip.

Table (5): Fatty acids (FA) composition of drip fat separated from frozen buffalo and camel meat stored at -20°C for six months.

Fatty acids (FA)	Buffalo			Camel		
	Storage time (months)			Storage time (months)		
	1	3	6	1	3	6
C 8:0	0.75	1.08	0.09	0.87	0.14	8.86
$C_{10:0}$	0.60	0.86	0.16	0.39	0.09	2.27
$C_{11:0}$	0.15	0.22	0.61	0.10	0.00	0.91
$C_{12:0}$	0.15	0.11	0.09	0.29	0.14	0.23
$C_{13:0}$	0.30	2.16	0.82	0.19	0.05	0.68
$C_{14:0}$	12.93	2.16	2.18	0.19	2.17	0.91
$C_{15:0}$	1.80	2.03	0.50	0.58	0.54	0.68
$C_{16:0}$	42.11	2.59	18.37	24.35	21.02	15.00
$C_{16:1}$	22.86	0.43	2.99	1.55	0.90	1.36
$C_{17:0}$	3.01	0.00	0.91	3.09	3.39	0.45
$C_{18:0}$	3.01	51.89	27.76	39.61	40.91	4.09
$C_{18:1}$	1.20	35.03	27.67	28.50	28.48	5.45
$C_{18:2}$	10.53	0.43	17.46	0.29	2.17	18.18
$C_{18:3}$	0.60	0.00	0.27	0.00	0.00	40.91
$C_{20:0}$	0.00	0.00	0.14	0.00	0.00	0.00
Total monoenoic	24.06	35.46	30.66	30.05	29.38	6.81
Total polyenoic	11.13	0.43	17.73	0.29	2.17	59.09
Total saturated FA	64.81	64.10	51.63	69.66	68.45	34.08
Total unsaturated FA	35.19	35.89	48.39	30.34	31.55	65.90

In the buffalo and camel meat drip $C_{18:1}$ constituted the major portion of the unsaturated fatty acids except in the first month of storage in the buffalo meat where $C_{16:1}$ constituted the major portion of the unsaturated fatty acids.

The presence of the fatty acids in the drip of meat may be due to the damage of the muscle by ice crystals and escape of the fatty acids with the separated fluids. Moreover, the fact that the drip lipids were more saturated than the meat lipids at any given time of storage is an attractive finding which is not yet explained. However, it might be suggested that unsaturated fatty acids were more borned to tissues by some charges reactions.

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