Studies on Some Market Meats in Egypt. I. Changes in Nitrogenous Compounds During Aging, Freezing and Storage

M. I. EL-GHARBAWI, M. A. ABDALLA AND
EL-MOUSSANA S. EL-GOUNDY[1]

ABSTRACT

The Longissimus dorsi of three different sources of market meats in Egypt, namely, buffalo veal, beef and camel were either aged at 40°F or frozen and stored at 14°F. Changes in moisture content and the different fractions of nitrogenous compounds extracted by buffer solution at pH 7.5 were followed at different intervals. In addition, the amino acid composition of aged meat exudate and that of the drip obtained from thawed frozen meat was determined. Changes in total soluble protein and non-protein nitrogen showed significant differences in patterns between the two technological treatments studied. The amino acid composition of both exudate and drip showed some qualitative differences.

INTRODUCTION

The principal sources of meat in Egypt are cattle, buffaloes, sheep and camels. Cattle yielding beef are usually fattened when they are 1–2 years of age. Buffalo male calves are slaughtered at the age of 4–10 weeks (2). Lamb is obtained from sheep 6–12 months of age whereas mutton is the product of older sheep. Young camels providing tender and high quality meat are killed at the age of 8–12 months.

In Egypt, meats are commonly marketed fresh immediately following slaughter. Aging, as a technological process to improve meat quality is not yet widely practiced in the country as it is in the U.S.A., Canada and most of the European countries. Aging or ripening of meat is carried out by hanging carcasses in cold rooms at 35°F for 1–4 weeks. However, today this process can be speeded up by holding carcasses at higher temperatures (68°F), for 48-hours. Such a process improves flavor, aroma, texture and palatability of meat through chemical and biochemical changes within the muscle tissues (5,6,7,8,9).

The local production of meats in Egypt is insufficient to meet the demand of the ever

[1] *M. I. El-Gharbawi, Department of Food Science, Faculty of Agriculture, University of Tripoli, Tripoli, Libyan Arab Republic and M. A. Abdalla and El-Moussana S. El-Goundy, Department of Food Science, Faculty of Agriculture, Ain Shams University, Cairo, Egypt.*

increasing population. This problem is overcome by the large importations of live animals as well as frozen meats by government agencies.

In this study some of the locally produced meats were aged or freezed and stored at different temperatures for varied storage periods. The changes in the various nitrogenous compounds in muscle tissue from different sources of meat were followed during storage under varied conditions.

MATERIAL AND METHODS

Meat samples

Longissimus dorsi muscles of buffalo veal (1–2 months old), beef (12–18 months old), and camel (8–12 months old), were obtained from the public slaughter-house at Giza immediately after carcass dressing. The meat samples were transferred to the Food Science Division, Ministry of Agriculture in a cooled box. Precautions were taken to avoid contact of meat with ice.

Meat samples of each source were divided into two lots: the first lot was aged at 40°F in a household refrigerator, and the second lot was freezed and stored at 14°F. All test samples were packed in polyethylene bags. Chemical analysis was carried out on samples withdrawn at different intervals.

Moisture determination

The water content of the meat samples was determined by drying in a thermostatically controlled vacuum oven maintained at 158°F.

Fractionation of nitrogenous compounds

The method suggested by Weinberg and Dayson (11), was followed to separate nitrogenous compounds into: total soluble nitrogen, protein nitrogen and non-protein nitrogen.

Nitrogen determination

Micro Kjeldahl method was used for nitrogen content of each of the above-mentioned nitrogenous compounds according to the A.O.A.C. (1). A mixed indicator composed of methyl red and bromocresol green was used for titration of excess boric acid with HCl.

Free amino acid determination

The free amino acid content of both the exudate from aged meat and the drip from frozen-thawed meat were separated and identified qualitatively by multiple technique ascending paper chromatography.

Elution was carried out with two solvent systems: first, by using a mixture of butanol: acetic acid: water, in a ratio of 4 : 1 : 5, according to Block *et al.* (3), and the second system used was a mixture of methyl-ethyl ketone : pyridine : water, in a ratio of 35 : 7.5 : 7.5 (3). After air-drying of the chromatogram, amino acids were developed by spraying with 0.5% ninhydrin in N-butanol saturated with water (1). Known amino acids were used as references to identify the amino acid components of the tested samples.

RESULTS AND DISCUSSION

Three different sources of market meats in Egypt, namely, buffalo veal, beef and camel were used in this investigation. The samples were obtained from the public slaughter-house at Giza immediately after carcass dressing. The meat was packed in polyethylene bags and stored at either 40°F for aging or at 14°F for freezing and storage. Samples were withdrawn at different intervals for chemical analysis.

Results in Table 1, showed that buffalo veal samples had the highest initial moisture content compared to beef and camel meats. However, camel meat had a relatively higher moisture content than that of beef. It was reported by many investigators (4,9), that veal muscles contained higher amounts of water than older animal tissues due to the fact that the latter contained higher amounts of fat and nitrogen.

Data presented in Table 1, showed that camel meat had the highest initial concentrations of total nitrogen, soluble nitrogen and protein nitrogen and non-soluble nitrogen compared to both veal and beef. Also, beef showed higher values for nitrogenous compounds than veal. Beef and camel meats were obtained from comparatively older and more developed animals therefore they showed higher amounts of nitrogenous compounds reflecting higher biological activities.

Table 2, showed the amino acids present in meat exudate following a one-week aging period at 40°F. Results indicated that the exudate from both veal and beef contained the same complement of amino acids, namely: cystine, lysine, histidine, arginine, aspartic acid, serine, glycine, glutamic acid, alanine, phenylalanine, leucine and isoleucine. However, the camel meat exudate lacked the last three amino acids.

There was an apparent increase in total nitrogen contents of all three types of meat during aging up to 15 days of storage. This may be correlated to the observed decrease in the moisture content of meat samples as shown in Table 1. The loss in moisture content of the meat samples was mainly due to losses in the form of exudate which differed in quantity between the three types of meats used in this study. This could be explained by the difference in water-holding capacity with veal tissues showing better water retention than beef or camel meat as indicated by Semyonova *et al.* (10). Maximum loss

Table 1 Changes in moisture and nitrogenous compounds of some market meats in Egypt during aging at 40°F.

Source of meat	Storage (day)	Moisture %	Nitrogenous compounds, %			
			Total nitrogen	Soluble nitrogen	Protein nitrogen	Non-protein sol. nitrogen
Buffalo veal	0	77.65	3.3750	0.8720	0.5808	0.2912
	3	76.55	3.3100	0.7404	0.4936	0.2468
	6	76.36	3.4120	0.7660	0.4936	0.2724
	15	75.50	3.5570	0.7724	0.5520	0.2204
Beef	0	75.40	3.6440	1.1440	0.7277	0.4163
	3	73.58	3.9480	1.0487	0.6100	0.4387
	6	73.28	4.1690	1.1175	0.6820	0.4355
	15	68.36	5.0080	1.1330	0.6950	0.4380
Camel	0	76.00	3.6700	1.5070	1.0470	0.4600
	3	74.20	3.8600	1.1330	0.7532	0.2798
	6	72.70	3.9280	1.1950	0.7085	0.4865
	15	71.40	4.8000	1.4360	0.9660	0.4700

Table 2 Free amino acids present in aged meat exudate and in the drip from frozen thawed meat of buffalo veal, beef and camel.

	Treatment					
	Aged meat exudate			Thawed meat drip		
	B. veal	Beef	Camel	B. veal	Beef	Camel
Alanine	+	+	+	+	+	+
Argenine	+	+	+	+	+	+
Aspartic acid	+	+	+	+	+	+
Cystine	+	+	+	+	+	+
Glutamic acid	+	+	+	+	+	+
Glycine	+	+	+	+	+	+
Histidine	+	+	+	+	+	+
Isoleucine	+	+	–	–	–	–
Leucine	+	+	–	–	–	–
Lysine	+	+	+	+	–	–
Phenylalanine	+	+	–	+	+	–
Serine	+	+	+	+	+	+

+ = amino acid present
– = amino acid not present.

in moisture content was 1.29% for veal, 2.12% for beef and 3.30% for camel meat after 6 days of cold storage. Additional moisture loss from the 6 to 15 days of storage came to 0.86%, 4.92% and 1.30% for the respective meats.

Soluble nitrogen contents of the three types of meat showed lowest values after 3 days for both veal and beef and after 6 days for camel meat. This was followed by gradual increase in the soluble nitrogen content. By the end of the 15 days test period, soluble nitrogen concentration in all three samples did not reach the initial concentrations. Both protein nitrogen and non-soluble nitrogen followed similar patterns of concentration as that of soluble protein. It appears that resolution of rigor mortis in camel meats takes place after a comparatively longer period of storage than beef and veal under similar conditions used in this study. Changes in solubility of nitrogenous compounds could be mainly due to autolysis during the last period of aging process.

Data presented in Table 3, showed that moisture content of all meat samples used in this investigation decreased slightly during storage at 14°F. The drop in the moisture content was in the range 0.95 to 1.2% and this loss could be explained by drip formation during preparation of the samples.

Generally, the total nitrogen content of the three types of meat studied showed that holding at 14°F in the frozen state lead to a slight but consistent increase (Table 3). Percentage increase for the 15 day storage period was 0.44%, 5.93% and 5.29% for buffalo veal, beef and camel meat, respectively.

The total amount of soluble nitrogen showed a decreasing pattern during the freezer storage period with reductions amounting to 5.98%, 4.83% and 18.85% for buffalo veal, beef and camel meat, respectively. These results can be associated with the changes in moisture content due to drip formation in addition to the mechanical damage resulting from large ice crystal formation during the slow freezing process applied in this study.

Data obtained (Table 3), indicated that protein nitrogen extracted by the buffer solution at pH 7.5 from the meat samples decreased gradually during the 15 day storage period. Meanwhile, there was a corresponding increase in soluble non-protein fraction

Table 3 Changes in moisture and nitrogenous compounds of some market meats in Egypt freezed and stored at 14°F.

Source of meat	Storage (day)	Moisture %	Nitrogenous compounds, %; Total nitrogen	Soluble nitrogen	Protein nitrogen	Non-protein sol. nitrogen
Buffalo veal	0	77.65	3.3750	0.8520	0.5808	0.2712
	3	77.20	3.3830	0.8480	0.5808	0.2712
	6	77.15	3.3830	0.8470	0.5807	0.2663
	15	76.70	3.3900	0.8010	0.5226	0.2784
Beef	0	75.40	3.6440	1.1440	0.7277	0.4163
	3	75.00	3.7740	1.1324	0.6970	0.4354
	6	74.80	3.7500	1.1175	0.6550	0.4625
	15	74.40	3.8620	1.0888	0.5801	0.5087
Camel	0	76.00	3.6700	1.5070	1.0470	0.4600
	3	75.30	3.7830	1.3980	0.9180	0.4800
	6	74.80	3.8000	1.3880	0.8050	0.5830
	15	74.80	3.8640	1.2230	0.7730	0.4500

of the meat extracts. Both changes may have resulted from proteolytic activity of intact enzymes within the muscles prior to reaching the complete frozen solid state and during sample preparation for analysis.

Drip obtained from thawed frozen meat samples differed in amino acid contents according to type of meat (Table 2). All drip samples lacked leucine and isoleucine whereas lysine was missing in both beef and camel meat. Phenylalanine was present in thawed meat drip of both buffalo veal and beef but not in camel meat. The differences in the numbers of amino acids in meat exudate held at 40°F and drip from thawed frozen meat can be attributed to the extent of proteolytic activity within tissues allowed by the two methods of storage.

LITERATURE CITED

1. Anonymous. 1965. Official Methods of Analysis (A.O.A.C.), Washington, D.C., U.S.A.
2. Asker, A. A. and M. T. Ragab. 1960. Fattening Egyptian steers in the Tahreer Province. Alexandria J. Agric. Res. 4 : 157.
3. Block, R. J., E. L. Durrum, and G. Zweing. 1958. A manual of paper chromatography and paper electrophoresis. 2nd. Ed. Academic Press, Inc., N.Y.
4. Darwish, M. Y. H. 1963. Meat Production. Anglo-Egyptian Press, Cairo, Egypt (In Arabic).
5. De-Fremery, D. 1963. Relation between biochemical properties and tenderness of poultry. Proc. Meat Tenderness Symposium, Camden, N.J., U.S.A.
6. El-Dashlouty, M. S. 1963. Post-mortem changes in the structure of sheep muscles. Proc. Acad. Agric. Sci., Moscow 85 : 264.
7. Golovkin, N. A., and L. A. Melozova. 1970. Changes of meat proteins during long periods of storage in the frozen form. Food Technol. 1 : 65 (Moscow).
8. Ramsbottom, J. M., and E. J. Strandine. 1949. Initial physical and chemical changes in beef as related to tenderness. J. Animal Sci. 8 : 398.
9. Sokolov, A. A., and A. R. Diklob. 1960. Technology of Meat and Meat Products. Food Industry Press. Moscow.

10. Sokolov, A. A. 1965. Physicochemical Basis of Meat Products. Food Industry Press. Moscow.
11. Weinberg, B., and R. Dayson. 1960. Changes in protein extractability during post-rigor tenderization of chicken breast muscles. Food Technol. 14 : 376.
12. Wierbicki, E., L. E. Kunkle, V. R. Cabill, and F. E. Deatherage. 1956. Post-mortem changes in meat and their possible relation to tenderness. Food Technol. 10 : 80.
13. Wierbicki, E., and F. E. Deatherage. 1958. Determination of water-holding capacity of fresh meat. J. Agric. Food Chem. 6 : 387.