PHYSICO-CHEMICAL AND MICROBIOLOGICAL CHANGES IN GROUND MEAT DURING FROZEN STORAGE

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ABSTRACT
Microbiological, chemical and physical changes in ground meat during frozen storage were examined over a period of five months. Samples were taken from 12 grounds meat producing firms, and stored at -18°C. The samples were analyzed before and after commercial freezing. Commercial freezing had no apparent effect on the chemical composition, while reduced water holding capacity and increased expressible fluid.

During frozen storage microbial load tended to decline over the storage period. Despite of the decrease in the microbial content, acid production, proteolysis and lipolysis proceeded in all samples, but at slow rates. There was a continuous decrease in pH, an increase in free amino N., total volatile bases nitrogen and free fatty acids. Fat oxidation was also apparent from the increase in thiobarbituric acid values after one month up to the third month and decreased by the end of the storage period, probably due to the interaction of malonaldhyde with accumulating free amino acids. Color, wafer hording capacity end expressible fluid were the properties most affected by frozen storage. There was a continuous reduction in red color intensity and in water holding capacity while expressible fluid increased. Generally, even after 5 months of storage all samples were quite acceptable. This suggest that ground meat could be kept frozen up to 5 months without apparent spoilage.
Key morals: Ground meat, Frozen storage, Quality changes.

INTRODUCTION

Quality and shelf-life of frozen food products have been of particular interest for researchers. Freezing rate, storage time and temperature, product composition and type of package were reported to be the main factors controlling the quality of frozen meat products (Bhattacharya et al., 1988). In assessment of the quality of frozen products different parameters have been suggested. In frozen meat products, changes in the microflora, protein, fat, color, pH, water holding capacity and sensory characteristics have been used (Pearson, 1968 and Reddy et al., 1975). Numerous data have been published concerning the changes which take place during frozen storage of meat and some common meat products (Duitschaever, 1977; Keeton and Melton, 1978 and Palumber et al., 1979). less studies appeared to have been carried out concerning the quality of ground meat. In a previous work microbiological and chemical changes in ground meat at marketing display were examined (Awed, 1996). In this study microbiological, chemical and physical changes during frozen storage of ground meat were assessed as a part of a continuing interest in the keeping quality of this type of meat product.

MATERIALS AND METHODS

Ground meat samples: Samples (36) were collected from 12 firms in Egypt then delivered in ice box to the Food Sci. Dept., Minia Univ. Microbiological and chemical analysis were carried out before and after freezing and at 1, 3 and 5 months of frozen storage at -18°C.

Micribiological analysis: Enumeration of total aerobic plate count (TAPC), total psychrophilic plate count (TPPC), proteolytic bacteria, lipolytic bacteria and coliform group were carried out as described by the American Public Health Association, (APHA, 1976). Counting of staphylococci, yeasts and molds and detection of salmonella and shigella were carried out according to DiDco Manual (1970).

Chemical analysis: Samples were analyzed for: pH, titratable acidity, moisture, fat, amino N., total volatile bases N.(TVBN) and free fatty acids (FFA) as described in the AOAC (1985); thiobarbituric acid (TBA) as the methodgivenbyTarladgiset al., (1960).Water holding capacity (WHC) and expressible fluid (EF) were determined using the method of Golavin (1969).

Changes in the color of ground meats were visually assessed.

RESULTS AND DISCUSSION

Storage studies are important in dertermining the shelf life of meat products, hence, samples were kept for 5 months at -18°C. Data for low fat samples(contained about 13.5%) and high fat samples (contained about 30.1%) were studied for comparison.

Microbio70gical changes: Results in Table 1 illustrate a drop in the counts of all groups of microorganisms with increasing time of storage. This was not surprising as counts in frozen meat are known to stabilize or even decrease during storage (Mates, 1983).Low fat samples had a lower microbial count than high fat samples. In both samples the counts of microorganisms decreased as storage time proceeded. Coliforms and molds and yeasts were absent after 3 and 5 months, respectively.

Chemical changes: Data presented in Table 1 also show that the pHofmeat samples which slightly decreased after freezing, increased after the first month of storage then decreased as storage time was extended up to 5 months. Opposite direction of that of pH was observed for titratable acidity. The data for amino N and TVBN indicated that protein underwent proteolysis over the frozen storage period, but the rate was apparently slow. Fat content had no effect on the pH changes and the rate of proteolysis. As in the case of protein, fat underwent lypolysis with increasing time of frozen storage. Fat content increased by about 0.65 in both meat samples at the end of storage. Oxidative products were not detected in the low fat samples before or after freezing, while TEA value was high in the high fat samples. TBA value increased after the first month up to the third month then decreased thereafter, probably due to the interaction ofmalonaldhyde with accumulating free amino acids values .

Changes in color, (WHCJ and EF: Extending the frozen storage up to 5 months resulted in a loss in products color, a decrease in WHC value and an increase in EF value.

However, although there are no data on the limit of changes in the chemical parameters, results indicated that ground meat could be kept up to 5 months under frozen storage. The present study also suggest that both microbial and chemical studies are important in predicting the storage period of frozen ground meat. Microbial studies alone not good enough indicators.

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Table (1) : Microbiological, chemical and physical changes in Low and high fat ground meat samples during frozen storage at -18°C.

Analysis and group of bacteria CFU/g	*Ground meat sample*	*Before freezing*	*After freezing*	*Storage (months)*		
				1	*3*	*5*
TAPC at 32°C	High fat	3.1×10^4	2.2×10^5	3.8×10^4	2.2×10^4	8.1×10^3
	Low fat	8.2×10^4	9.1×10^3	4.8×10^4	7.1×10^2	6.8×10^2
TPPC at 7°C	High fat	3.4×10^5	1.9×10^5	2.2×10^5	1.6×10^5	5.4×10^4
	Low fat	1.9×10^4	7.5×10^3	1.1×10^4	3.5×10^3	1.2×10^3
Proteolytic bacteria	High fat	6.8×10^4	1.4×10^4	1.2×10^5	6.7×10^4	2.6×10^4
	Low fat	7.2×10^2	2.7×10^2	6.8×10^2	1.2×10^2	1.1×10^2
Lipolytic bacteria	High fat	1.1×10^4	8.2×10^3	6.7×10^3	4.8×10^2	3.1×10^2
	Low fat	4.6×10^2	1.6×10^2	4.6×10	3.2×10	2.5×10
Coliforms	High fat	3.2×10^2	9.4×10	6.7×10	3.8×10	1.2×10
	Low fat	1.1×10	< 10	<3	-	-
Staphylococci	High fat	1.1×10^3	3.4×10^2	1.7×10^2	9.1×10	6.1×10
	Low fat	8.6×10	4.5×10	2.2×10	< 10	<5
Yeasts and Molds	High fat	5.4×10^2	2.1×10^2	6.3×10	1.8×10	< 3
	Low fat	5.6×10	3.3×10	1.5×10	<10	-
pH	High fat	5.60	5.60	6.10	5.00	5.00
	Low fat	5.90	6.00	6.50	5.70	5.30
Titratable acidity %	High fat	0.95	0.93	0.85	1.03	1.03
	Low fat	1.07	1.08	1.01	1.03	1.08
TVBN mg/100g	High fat	19.65	19.16	20.80	22.75	22.95
	Low fat	18.40	17.90	18.35	18.67	19.50
Amino N mg/100g	High fat	71.60	70.50	75.80	96.80	112.60
	Low fat	78.30	75.80	85.60	104.50	118.50
FFA %	High fat	1.14	1.12	1.25	1.46	1.77
	Low fat	0.68	0.65	1.02	1.18	1.36
TBA value mg/kg	High fat	0.45	0.43	0.47	0.29	0.26
sample	Low fat	0.00	0.00	0.31	0.24	0.21
WHC value	High fat	42.30	24.80	22.40	21.90	20.10
	Low fat	53.60	36.30	28.60	25.20	24.20
EF value	High fat	57.70	75.20	77.60	78.10	79.90
	Low fat	46.40	63.70	71.40	74.80	75.80

Data are average of 36 samples.