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Effect of thawing cutting and transportation on frozen beef quality characteristics imported to Egypt.

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Introduction

Egypt imports about 250.000 tons of beef meat yearly, mainly imported from European countries, Argentina and Australia by ships in the frozen form.

Most of the imported beef reaching the Egyptian ports are complete carcasses. which are thawed, cut to small pieces, packaged and refrozen to be transported theconsumption areas. Fields et al. (1976) reported that thawing of frozen carcasses for several hours at relatively high temperature affected sarcomere length and declined meat tendernes . Locker et al., (1975) reviewed that changes occured in beef meat were sensitive to processing and resulted in weight losses and alteration in beef meat properties. Ashrae (1974) mentioned that thawing frozen carcasses for 24 hours resulted in raising bacterial load of meat surface, raising meat toughness, shrinkage of beef meat because of weight losses as a result of separation of meat fluids, changes in chemical composition and energy calory levelos.

It was assumed that alteration in the imported beef meat to Egypt might occur as a result of processings after arrival. So, this research was initiated to determine the effect of thawing, cutting, packaging and transportation to consumption areas on beef meat quality under the Egyptian conditions of weather and facilities.

MATERIALS AND METHODS

a. MATERIALS :

The raw material used in this research was beef meat imported to Alexandria (Egypt). About 248 whole carcasses were followed at all stages of thawing, cutting, packaging and transportation to other areas of distribution and consumption.

Weight of carcasses varied from 316 to 400 Kg.

Deep round, semitendinosus and gluteus medius muscles were selected for measurements.

b. METHODS :

1. Sarcomere Length :

Measurements were recorded to imported beef muscles samples at all stages of processing. Samples were taken from muscles using core borer (diameter 0.08 cm., length 15 cm.). Sarcomere length represents the mean of 15 expreiments, expressed in micrometer (ūm). The method was described by Locker (1960).

2. Weight Losses :

Selected carcasses were weighed in its frozen form and after 24 hours of thawing. Reduction of weight was determined as the difference pre and after thawing weights as described by Ashrae (1974).

3. Colour Changes (Reflectance) :

The changes in colour reflectance were measured in three ranges, red (640 um), green (546 um) and blue (436 um) using a tristimulus coloremeter calibrated at 90% reflectance to a white calibration sheet as mentioned by Shults et al., (1977).

4. Fractionation of Amino Acids in Drip :

Two dimentional paper chromatography separation of amino acids in the drip of carcasses thawing fluids was performed, using the method indicated by Plummer (1977).

5. Chemical Analysis :

1 Kg of beef meat from each selected muscles was used in analysis. Moisture, protein, fat and ash were determined according to the A. O. A. C. (1970).

Random selection of $10cm^2$ areas of carcasses were swabbed with a steril cotton moistened with phosphate buffer. Serial dilutions of samples were plated on plate count agar and incubated at 32^oC for 48 hrs.

6. Microbial counts were recorded as the mean count of samples. Mackonki media test for Coliform bacteria existance was conducted. The method was reported by Glover et al. ,(1977).

7. Meat tenderness :

Was determined by Warner- Bratzler (W-B) shear readin gs as the method of Bramblet et al.(1963).

Data of sarcomere length, weight losses, microbial count and Warner-Bratzler shear readings were statistically analyzed using t-test, (Ostle, 1974).

RESULTS AND DISCRUSSION

Sarcomer Length :

Results in Table 1 declared that sarcomere length was affected by exposing the frozen beef carcasses to room temperature for thawing, as there was no facilities of keeping carcasses at chilled rooms (2-3°C). In all the muscles studied during all stages of processing, differences were highly significant ($P < 0.01$) and ($P < 0.05$). On comparing sarcomere length of thawed beef after 24 hours of thawing (2.18 um) with control samples sarcomere length (2.32 um), it was noticed that sarcomere length of muscles was shortened by 6% after thawing. During other stages of processings, the contraction in sarcomere length gradually progressed. Cutting within six hours of complete thawing dropped sarcomere length further to (2.05 um) representing of about 11.5% shortening in sarcomere length.

Table 1 : Effect of processing of frozen beef meat on sarcomere length.

Meat Processing	Sarcomere length	% shortening
Control (just arrived)	2.32	0
Thawing for 24 hours	2.18	6
Cutting	2.11	9
Transportation	2.05	11.5

These reaults may be due to the high thawing temperature that must have contributed to the shortening of sarcomere length. Besides, as carcasses were presumably frozen the pre-rigor state, rigor mortis must have occurred during thawing with resulting thaw contracture. This opinion was confirmed by Bendall (1972) who pointed out that the critical temperature of muscle for the shortening is 11°C. So, higher temperature caused shortening effect. This goes parallel with the Egyptian weather conditions.

Weight Losses :

Percentages of weight losses after thawing and during other stages of processing were significant($P < 0.05$).

Table 2 ; showed that thawing carcasses for 24 hours resulted in 3.4% weight loss, cutting the thawed beef caused 0.83% weight loss and transportation to consumption areas caused about 1.02% weight loss within six hours of transportation. This is a total weight losses of 5.25%.

Table 2 : Effect of thawing, cutting and transportation on weight losses of frozen beef.

Meat Processing	% Weight losses
Control (just arrived)	0.00
Thawing for 24 hours	3.40
Cutting	4.23
Transportation	5.25

These high percentages of weight losses to the frozen imported beef may be due to the relatively high temperature of the weather in Egypt.

The high weather temperature caused a quick melting of the ice crystals in the frozen muscles and fibers as well as the connective tissues that resulted in the separation of meat drip fluids that contain soluble compounds and lead finally to the weight losses with such high magnitude. Compareable results were reported by Locker et al., (1975).

Colour Changes :

Reflectance colour values in three ranges (red 640 µm, green 546 µm and blue 436 µm) during all processing stages are shown in Table 3. Results declared that all samples exhibited colour fading during the mentioned stages of thawing, cutting and transportation. The means of 15 riplication represent the obtained values.

Table 3 : Effect of thawing, cutting and transportation on meat colour of frozen beef imported to Egypt.

Meat Processing	Wave length (um)	% Reflectance
Control (just arrived)	640 µm (red)	54.8
	546 µm (green)	16.7
	436 µm (blue)	12.5
Thawing for 24 hours	640 µm (red)	51.8
	546 µm (green)	14.3
	436 µm (blue)	10.6
Cutting	640 µm (red)	50.2
	546 µm (green)	12.7
	436 µm (blue)	10.1
Transportation	640 µm (red)	49.5
	546 µm (green)	11.3
	436 µm (blue)	9.2

Results declared that all samples exhibited colour fading during the stages of processing.

The fading in colour of frozen beef after processing may by due to the separation of meat fluids as a result of ice melting. Such fluids contain colouring agents of meat- like hemoglobin and myoglobin, hence, separation of these agents may cause colour fading. On the other hand, the exposure of meat to light during thawing for 24 hours may affect greatly its colour. These results were confirmed by U. S. D. A. (1975) and in accordance with the findings of Ashrae (1974). Colour fading was regarded after 2 hours of exposure to day light.

Separation of Amino Acids :

The fluids that dripped from imported beef were collected during the thawing process and were fractionated by two dimentional paper chromatography as reported by Plummer (1977) .

Paper chromatography resulted in the fractionation of four amino acids which were not identified. However, the release of these amino acids mus have altered chemical composition of meat as well as its quality. It was suggested by Seideman et al., (1977) that separation of drip from beef meat reduced its mutritive value as well as its quality and acceptability.

Chemical Analysis : The chemical analysis of imported beef is shown in Table 4. It was clearly noticed that processeing of imported meat affected and altered its chemical composition.

Table 4 : Effect of thawing, cutting and transportation on the chemical composition of frozen imported beef.

Meat Processing	Chemical Analysis of meat.			
	Moisture %	Protein %	Fat%	Ash%
Control (just arrived)	62.80	26.48	8.22	2.50
Thawing for 24 hours	61.45	25.86	10.23	2.46
Cutting	61.10	25.77	10.81	2.33
Transportation	60.84	25.74	11.13	2.28

After 24 hours period of thawing it was obvious that the moisture percentage was decreased from 62.80% to 61.45% as a result of the separated drip. The cutting process caused further reduction of moisture to 61.10%. Transportation of the cut beef meat to distribution areas within six hours period resulted in the decrement of meat miosture to 60.84%.With a similar trend the percentage of protein and ash were reduced.

On the contrary, the fat percentage was increased after processing as a result of the separation of meat fluids by thawing and evaporation, while , fat tissues contain few amount of moisture comparing with muscle tissues in beef meat. This opinion was also confirmed with what had been reported by Fields (1976).

Microbial Count :

Table 5 declared that the microbial load per cm^2 of meat surface upon arrival in the frozen form was 2.47×10^3. Thawing for 24 hours at room temperature resulted in a sudden increase in the bacterial load of meat surface as it reached 1.62×10^4 microorganism per cm^2. The increase was highly significant ($P < 0.05$) and ($P < 0.01$).

At the end of cutting process, the microbial count was increased to 1.85×10^4 per cm^2. Transportation for about six hours raised the bacterial load to 2.19×10^4, which was a significant increase ($P < 0.05$).

Table 5 : Effect of thawing, cutting and transportation on bacterial load of meat surface.

Meat Processing	Bacterial count per cm^2	Coliform
Control (just arrived)	2.47×10^3	00
Thawing	1.62×10^4	00
Cutting	1.85×10^4	00
Transportation	2.19×10^4	00

It was suggested that the high increment of the microbial count for meat surface may be due to the weather condition and high temperature of processing resulting in the separation of meat fluids that dripped from meat surface which contain soluble nutrients, thus, provided the microorganisms at the meat surface with a very suitable medium for growth to reach the highest limits that have been proposed for fresh meat by Kotula (1970).

As a result of hygenic percautions, during processing, Coliform bacteria was not detected in all the above mentioned determinations. The increase in bacterial growth may also affect meat quality as it causes protein hydrolysis as well as the production of some toxic and off flavour products which reduced meat quality, acceptability and altered its chemical composition.

Meat Tenderness :

Warner-Bratzler shear values which are considered a good indication for meat tenderness, declared that processing declined meat tenderness, as a result of the increase of Warner- Bratzler shear values as reported in Table 6.

Table 6 : Feffect of thawing, cutting and transportation on imported meat tenderness.

Meat Processing	Warner- Bratzler shear values (Kg)
Control (just arrived)	1. 31
Thawing	3. 27
Cutting	3. 42
Transpotation	3. 51

The increase in the shear press values was significant ($P<0.05$). The control sample had a shear value of 3.31 Kg. Thawing process resulted in a further increase to 3. 27 Kg after 24 hours thawing period. Cutting the carcasses caused also decrease in tenderness as the shear value was raised to 3. 42 Kg, while transportation of beef cuttings raised it to 3. 51 Kg leading to the decline of meat tenderness.

The increase in meat toughness or the reduction of meat tenderness may be due to the separation of meat fluids during thawing and the shrinkage happened which affected meat quality and raised its resistance to shear after cooking. This opinion was confirmed by Ashrae (1974).

So, it could be suggested that because of the relatively high temperature of the weather in Egypt and the shortage in facilities for good chilling storage, the beef meat may be imported to Egypt or any similar area in the form of small weight cut of about 10 to 20 Kg , boneless and already packed before freezing. So, shipments of meat can be transported directly within short time after arrival to the distribution areas without passing through other processings which lowered meat quality and value.

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