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Effect of Different Thawing Methods on Physico-Chemical Characteristics of Frozen Buffalo Meat

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Abstract: A study to assess the effect of different methods of thawing viz., Room Temperature (RT), Chiller Temperature (CT) and Microwave (MW) and Water Bath (WB) on physico-chemical characteristics of frozen buffalo meat was carried out. Results indicated that microwave thawing was the quickest method (10 min) followed by water bath thawing while room temperature thawing and chiller temperature hawing took longer duration. A highly significant difference ($p<0.01$) in WB Shear force value was observed in samples thawed at RT and WB, RT and MW and CT and MW treatments. A highly significant ($p<0.01$) difference in munsell chroma and drip loss of meat samples between different treatments. The highest drip loss was recorded in WB thawing followed by RT thawing. MW thawing showed a highly significant ($p<0.01$) difference recording the lowest cooking loss compared to that of RT, CT and WB thawing methods. It was found that microwave thawing was the quickest compared to other methods and had lower cooking loss.

Key words: Thawing, buffalo meat, freezing, cooking loss, colour, treatment

INTRODUCTION

Low temperature storage is a classical technology for conservation and storage of meat and meat foodstuffs (Reid, 1997). In India, most of the meat is purchased by the consumers in fresh or frozen form. To adjust with the fast growing life style of urbanization they hardly find time to purchase meat daily. Hence, they purchase meat in bulk to meet their daily requirements. This meat is stored in refrigerator and consumed on definite intervals. Frozen meat needs to be thawed before further processing. Hence, details of appropriate technology for effective thawing has to be available with the consumers for better meat quality. The scientific information on the effect of freezing and thawing is scarce. Hence, the present study was undertaken to assess the time taken for the meat to thaw by different thawing methods and to compare the effect of these methods on certain physico-chemical characteristics of buffalo meat. The result of the study will be helpful to the meat industry in maintaining the quality and improving the knowledge of meat processors and consumers regarding the effects on quality of meat on account of different thawing procedures and application of suitable methods for thawing of frozen meats without much deleterious effect.

MATERIALS AND METHODS

Fresh samples from buffalo round muscles were collected from the animals slaughtered as per standard procedures in the Department of Meat Science and Technology, Chennai. After removing the separable fat and tendons, samples were cut into pieces each weighing 1 kg. The pieces were placed individually in self locking Low Density Poly-Ethylene (LDPE) pouches and were stored at 2±1°C for 24 h for postmortem ageing and then frozen at -20±1°C for 48 h. Representative samples were taken to assess the time taken for freezing of 1 and 2 kg meat pieces with and without pre-chilling. About 12 replicate samples of frozen buffalo meat were subjected to 4 different methods of thawing to ascertain the effects of freezing and thawing on various meat qualities.

Room Temperature (RT), Chiller Temperature (CT) and Microwave (MW) was performed as per the method outlined by Ziauddin and Rao (1992) with modifications in temperature at 35±2°C, 4±1°C and power supply of 315 W, respectively. Water Bath (WB) thawing was performed as per the method described by Nilsson and Ekstrand at a temperature of 45±1°C. The time taken for thawing of frozen meat in all the methods was recorded as the time taken by the meat pieces to reach a core temperature of 1°C. After thawing physico-chemical characteristics viz. pH, Shear force value, color, drip loss, cooking loss and muscle shortening were studied.

Parameters

pH: The pH of frozen thawed buffalo meat was estimated using digital pH meter (Toshniwal, India). About 30 g pf sample was taken in a glass thimble, pierces by a bayonet type electrode (Bouton *et al*., 1971) and pH was recorded.

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SWB-Shearforce value: Meat cores were taken using a metal corer of diameter 1.27 cm, along the direction of muscle fiber. Then the cores were sheared through Warner-Bratzler meat shear (G.R. Electric Manufacturing Company, Manhattan, U.S.A.) device. About 3 readings were taken from each core and the average of the 3 readings were recorded as the mean shear force value, expressed in kg cm^{-2}.

Color: The colour thawed frozen samples were recorded using Munsell book of colour (1976 edition) under standard conditions as specified in the manual. The Munsell book of colour represents an approximation to a perceptually uniform organization of colour stimuli in 3 dimensional spaces (ASTM Designation: D 1535-80 and ASTM Designation: D 1729-69, reapproved, 1974). The system is constructed on a 100 step hue scale, H; a 10 step value (lightness) scale, V and a chroma scale (a measure of saturation) C from 0 (achromatic) to a maximum characteristic of each hue at each value level. The 3 dimensional specification is written as H V/C and the meat sample colour can be defined by visual matching to the colour chips in the Munsell collection.

Drip loss: The amount of drip in each pack was estimated by weighing the pack of buffalo meat sample before opening and subtracting the weight of the meat sample plus packaging film after blot drying. Drip loss was expressed as percentage of initial weight of meat sample.

Muscle shortening: Measurement was done according to the procedure of Xiong and Blanchard (1993) with modification. Percent shortening was defined as the net reduction in muscle strip length (cm) after thawing divided by the original muscle (cm) length and multiplied by 100.

$$\text{Percent muscle shortening} = \frac{\text{Reduction in muscle length (cm) after thawing}}{\text{Original muscle length (cm)}} \times 100$$

Cooking loss: It was estimated according to the procedure of Acton (1972) with modification. The weight of the fluid exudates drained from the meat is reported as the percent cooking loss, based on the initial meat weight. Cooking of thawed meat samples were done at 70°C for 30 min in a waterbath. The data obtained in this study were analyzed statistically as per the method outlined by Snedecor and Cochran (1994).

RESULTS AND DISCUSSION

Results revealed that buffalo meat of 1 and 2 kg took 5 h 45 min and 6 h 50 min, respectively for freezing with pre-chilling for 24 h while it took 7 h 15 min and 8 h 5 min for the same without pre-chilling and hence, pre-chilling was found to greatly reduce the freezing time (Zhao *et al*., 1998). The results (Table 1) clearly indicated that microwave thawing was the quickest method (10 min) followed by waterbath thawing while room temperature thawing and chiller temperature hawing took longer duration.

The different thawing methods (Ziauddin *et al*., 1993). A highly significant difference ($p<0.01$) in Warner Bratzler Shearforce value was observed in samples thawed at RT and WB, RT and MW and CT and MW treatments whereas a non significant ($p<0.05$) difference was observed between RT and CT thawed meat samples. MW thawing resulted in higher Shearforce values which were in contradiction with the findings of Ziauddin *et al*. (1993) and in agreement with Pizzocaro and Franzethi

Table 1: Mean±SE of physico-chemical characteristics of frozen buffalo meat thawed by different methods

	Thawing methods			
Parameters	Room temperature (35±2°C)	Chiller temperature (4±1°C)	Waterbath (45±1°C)	Microwave (315 W)
pH	5.76±0.020	5.72±0.020	5.71±0.01000	5.74±0.010
WB-Shearforce value (Kg cm^{-2})	4.687±0.15^{a}	4.033±0.27^{a}	6.491±0.2100^{b}	7.772±0.29^{c}
Drip loss (%)	1.57±0.080^{b}	1.04±0.120^{a}	2.27±0.12000^{c}	1.00±0.060^{a}
Cooking loss (%)	23.54±1.090^{b}	22.08±0.390^{b}	2.50.25^{b}±1.13	12.83±1.020^{a}
Muscle shortening (%)	1.52±0.190	1.16±0.190	1.39±0.22000	1.34±0.300
Munsell color				
Hue	6.04±0.480	7.08±0.420	7.50±0.75000	7.92±0.280
Value	4.75±0.350	4.00±0.250	4.75±0.35000	5.33±0.430
Chroma	9.17±0.390^{b}	9.50±0.260^{b}	8.00±0.49000^{ab}	7.50±0.440^{a}

		Mean squares							
Source of variation	df	pH	WB- Shear force value	Drip loss	Cooking loss	Muscle shortening	Hue	Value	Chroma
Analysis of variance									
Between methods	3	0.070^{NS}	34.850**	4.227**	369.4800**	0.270^{NS}	7.770^{NS}	3.853^{NS}	10.750**
Error	44	0.005	0.910	0.112	10.9800	0.629	3.161	1.148	1.947

*Means bearing different superscripts (a-c) between columns differ significantly ($p<0.01$); **Highly significant ($p<0.01$); NS: Not significant ($p<0.05$)

(1983) and Moody *et al.* (1978) with lowest value being recorded in CT followed by RT and WB thawing. The findings were in accordance with Ziauddin and Rao (1992). Variation in pH was found to be non significant ($p<0.05$) between ANOVA revealed a non significant difference ($p<0.05$) between the thawing methods with respect to munsell hue and value (Jeremiah *et al.*, 1972), whereas a highly significant ($p<0.01$) difference in munsell chroma of meat samples was observed between treatments (Babu, 1997).

Further critical analysis revealed a non significant ($p<0.05$) difference in chroma between RT and CT; RT and WB and WB and MW, whereas RT and MW and CT and MW thawing methods showed a highly significant difference ($p<0.01$).

A highly significant difference ($p<0.01$) was seen drip loss of meat samples between different treatments.

Critical difference analysis indicated a non significant difference between CT and MW thawing methods whereas a highly significant ($p<0.01$) difference existed between other combinations. The highest drip loss was recorded in WB thawing followed by RT thawing which might be due to exposure of frozen meat to higher temperature (Westerman *et al.*, 1949) and the lowest drip loss in microwave thawing (James *et al.*, 1984).

Muscle shortening showed a non significant ($p<0.05$) difference between different thawing methods and may be due to the fact that the meat samples were pre-chilled for 24 h before freezing and muscle shortening seldom occurs in post rigor meat during thawing (Lawrie, 1991). MW thawing showed a highly significant ($p<0.01$) difference recording the lowest cooking loss compared to that of RT, CT and WB thawing methods (Ziauddin *et al.*, 1993; Marriott *et al.*, 1980).

CONCLUSION

Based on the findings it was found that microwave thawing was the quickest compared to other methods and had lower cooking loss. The difference between MW and CT thawing in terms of drip loss was insignificant so, as in pH and color also.

But CT thawing recorded the least Shearforce value and more tender meat compared to MW thawing which recorded higher shear values. Hence it is advocated that it is best to thaw the frozen buffalo meat under Chiller temperature. Room temperature and water bath thawing were considered less reliable because of their nature of producing more product loss and less tender meat.

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