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Influence of Freezing Time on the Quality of Beef

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Abstract: Fresh meat (M_1), Minced meat (M_2), Minced meat with 4% sucrose + 0.3% polyphosphate (M_3), Minced meat with 4% sorbitol + 0.3% polyphosphate (M_4), and minced meat with 4% sucrose + 4% sorbitol + 0.3% polyphosphate (M_5) were used to evaluate the influence of freezing time on the quality of beef during 80 days of frozen storage period at every 20 days time interval. Sensory evaluation of general appearance, color, smell, consistency of flesh of all meat samples were done by a panel of five members and found the beef samples in acceptable condition. Proximate composition of M_1, M_2, M_3, M_4 and M_5 decreased gradually with the increase of storage period. The initial protein, lipid, ash and moisture content of all samples were ranged 22.06 to 23.41%, 3.84 to 4.20%, 1.02 % to 1.16% and 70.28 to 72.00%, respectively. The initial pH value was 5.6, which decreased up to 20 days and then increased up to the end of the storage period. The initial expressible moisture, total Volatile Base Nitrogen (TVB-N) and peroxide value was lower and this value gradually increased with the advancement of storage period. The solubility of fresh meat was ranged from 81 to 94.5% initially and declined with the advancement of storage period. More rapid decline of solubility was observed in Minced meat (M_2) and lowest decreasing was observed in Minced meat with 4% sucrose + 4% sorbitol + 0.3% polyphosphate (M_5). Among all the samples the quality decreasing trend was highest in fresh Minced meat (M_2) and comparatively lower in the Minced meat with cry-protective agents.

Key words: Freezing time, Quality, Beef, Proximate composition

Introduction

Meat is one of the most concentrated and easily assimiable nitrogenous food that contains those amino acids, polyunsaturated fatty acids as well as vitamins and minerals that are essential for human brain development which includes beef, pork, mutton, and poultry meat. It is reported that 75% of the world cattle population is in the developing countries (Asia, Africa & Latin America), but it contributes only 34% of the beef production (Rahman, 1992). The annual meat production in Bangladesh is about 0.744 million metric ton where the beef contributes 0.183 million metric ton of the total meat production (FAO, 1997). The average per capita daily intake of beef in Bangladesh is about 5 g. The beef and veal production per animal is much lower than those produced in many countries of the world. The major causes of lower production of beef per animal are shortage of grazing land, lack of balance feed and green grass, and problem to rear high breed cattle in our local atmosphere and weather (Alam, 1995). Freezing in the term that employed to preserve food product in a condition that most closely resembles the fresh product. Meat preservation is primarily concerned with controlling microbial contamination and autolytic changes caused by enzymatic action at cellular level. The rate at which meat is frozen and preservatives used may influence its quality. Ensuring lengthy shelf life cryoprotectants are used in meat industry in developed countries. However, there is no information about the suitable and available cryoprotectant which can be used in our country. Therefore, an attempt was made to investigate the following objectives:

To observe the organoleptic quality changes during frozen storage condition of beef.
To explore the suitable and effective methods for preserving beef.

Materials and Methods

Materials collection: Five samples of beef with different cryo-preservatives were studied in this experiment. 10 kg of beef from freshly slaughtered cattle were purchased from "Kamal-Ranjit Market", Bangladesh Agricultural University Campus, Mymensingh at 7.30 am on 10 September 2003. Then the meat sample was immediately moved to the Fisheries Technology laboratory.

Sample Preparation: Beef sample was then taken in a bowl, the remaining fat and bone were removed from the beef with the help of knife and then fresh muscle was collected for the experiment. Then 4/5th of block meat was grinded, by meat grinder, the rest 1/5th was remain ungrinded. From the block meat 200 g meat was weighed and packed in a poly bag. In this way 5 samples were prepared and were labeled (M_1). The rest meat was grinded in a meat grinder (M_2). Then 200 g of the grinded meat was taken in a pot and 4% of sucrose (8 g) was mixed property and packed in a poly bag and was labeled (M_3). In this way 5 samples were prepared. Again 5 samples each of 200 g meat were taken in five and 4% sorbitol (8 g) was mixed properly and then packed and labeled (M_4). Again 5 samples weighing each of 200 g meat was taken in five and 4% sucrose, 4% sorbitol and 0.3% polyphosphate, was mixed properly and then packed and labeled (M_5). One sample from each group was taken for proximate and biochemical analyses and rest of the sample were stored in -20'C temperature during the period of study.

Peroxide Value Determination: This parameter is monitored on the lipid, extracted from the beef muscle. At first it is required to prepare the extraction of beef lipid. The method of lipid extraction is as follows: A representative sample of 10 g was taken from skinned, finely hornogenized beef muscle. The sample was adjusted to contain as near as possible 16 ml of water in a homogenizing flask. A volume of 20ml of chloroform was pipetted and homogenized for further one minute. The homogenate was transferred to glass centrifuge tubes, balanced to 1g and centrifuged at 2000 rpm for 20 minutes. After centrifugation the aqueous layer and tissues were removed. The remaining tissues in chloroform were removed by filtering through Whatman no. I filter paper. A suitable amount of chloroform extract was added to dry. Preweighed 100 ml. round bottomed flask and evaporated at 35^{0}C using a rotary evaporator. Drying of oil was

performed at 600C. This oil or fat is used for the determination of peroxide value.

Preparation of Myofibrils: Myofibrils were prepared from ordinary muscles immediately after excision. The muscle was chopped by using a meat grinder and chilled minced muscle (50g) was homogenized for I min in 5 volumes of 39 mM borate buffer (pH7.1) containing 25 mM KCI and 0.1 mM Dithiothreitol (DTT). The homogenate was centrifuged for 15 min. The light-colored upper layer of the residue consisting mainly of myofibril was recovered with small volume of 39 mM borate buffer (pH7.1) containing 0.1 M KCI and 0.1mM DTT. The suspension was centrifuged for 15 min to remove the supernatant. Myofibrils were resuspended in the same solution and coarse materials removed by centrifuging at 400 x g. The suspension was centrifuged again for 15 min at 600 x g to sediment the myofibril. After the pellet was washed three times in the same way, and myofibrils were suspended with a desired volume of 39 mM borate buffer (pH7.1) containing 0.1m KC1 and 0.1mM DTT to make a concentration of 10-15 mg/ml.

Statistical Analyses: The data were analysed in Randomized Complete Block Design using Computer Program MSTATC. Duncans Multiple Range Test was done to compare the treatment variation.

Results and Discussion

Protein: It was observed that the initial protein contents were in the range of 22.02 to 23.41 % with highest value in fresh block meat (M_1) and lowest in mince meat with 4% sucrose + 4% sorbitol + 0.3% polyphosphate (M_5). There was a little change in protein content in all samples until 20 days of storage. Then there was decreasing pattern of protein content in all samples and protein content declined greatly in fresh meat followed by minced meat without using any kinds of cryo-protectants. On the other hand the loss of protein content was minimum in (M_5) and (M_4) where sorbitol and sucrose were used in combination or independently. The loss of protein content irrespective which may be related to drip loss after thawing of the samples. Sarcoplasmic protein (water soluble protein) may be lost during frozen storage in the form of drip loss. The results obtained from the present study are in agreement with (Sama *et al*., 1994 and Baowu *et al*., 1997).

Lipid: It appears that the initial lipid content was in the range of 3.84 to 4.20%. Lipid values were gradually decreased during the increase of storage period. At the end of the 80 days of storage, these values were in the range of 2.25 to 3.11% with maximum in M_3 and minimum in M_2 and M_4.

Ash: It was observed that the initial ash content was in the range of 1.0-1.16%. There was a little or more change in ash content during the Ist 40 days of frozen storage. Apparently ash content slightly decreased during 80 days of storage in all samples. But on the dry matter basis there was little or more change in ash content during 80 days of storage in all samples.

Moisture: It appears that the initial moisture content was in the range of 70.28% to 70% with highest in M_2 and the lowest in M_4. There were little changes in moisture content during the 1st 20 days of storage in all samples. The moisture content started to decline after 20 days of storage where moisture content decreased with the increase of storage period. At the end of 80 days of frozen storage moisture content reached to the range of 65.82 to 67.24% with maximum decrease in M_2 and minimum decrease in M_3. The highest level of moisture content decrease was in M_2 followed by M_5 and M_1 respectively. The maximum decrease of moisture content in M_2 may be related to osmotic action of sugar and sorbitol. However, there was a great decrease in moisture in all samples that are possibly related to post mortem drip loss after thawing (Szmanko *et al*., 1997).

Expressible Moisture: It shows that the initial expressible moisture content was in the range of 45 to 48% which remains more or less stable during the Ist 20 days of frozen storage. Then the expressible moisture content gradually increased with the lapse of storage period in all samples. The expressible moisture content increased in the range of 53 to 61% with the highest value M_1 and M_2 and the lowest value in M_4 and M_5. Samples M_1 and M_2 were stored without cryoprotectants and in the samples the expressible moisture contents were higher compared to those of M_3, M_4 and M_5 where sorbitol and sucrose were used in combination or independently.

pH: It appears that the initial pH value was 5.6. The initial pH value decreased gradually during the Ist 20 days of storage in all the samples. Then the pH values gradually increased during the advancement of storage period and at the end of 80 days of storage the pH value increased to 5.85 to 6.06%. In this study the samples of beef were taken 2 hrs after slaughtering when the samples might have been in a stage of post mortern changes. This is why the initial pH value was declined to 5.6 instead of around 7. The increase of pH after 40 days of storage is assumed to be an accumulation of some basic substances due to denaturation of protein during frozen storage.

Per Oxide: It was observed that the initial per oxide value was in the range of 1.2 to 1.70 m.eq/kg that gradually increased in all the samples under different storage condition. After 80 days of storage this value reached the range of 13.60 to 15.80 m.eq/kg.The result on peroxide value is in agreement with the organoleptic quality changes in meat during storage. The initial red color of the meat was changed to more darken color at the end of frozen storage which is due to oxidation of lipid during frozen storage. It is assumed that the oxidation of lipid contributed greatly with the increase of peroxide value during storage period.

TVB-N: It shows that the initial TVB-N values ranged from 6.7 to 11.80 mg/100g. The lowest value was observed in minced meat with 4% sucrose + 4% sorbitol +0.3% polyphosphate (M_5).The TVB-N values were increased gradually with the increase of storage period (Jay, 1975) . At the end of 80 days of frozen storage TVB-N values of all samples increased and ranged from 21.90 to 27.00 mg/100 with highest increase in fresh minced meat M_1 and lowest increase in minced meat with 4% sucrose + 4% sorbitol + 0.3% polyphosphate

M_5.TVBN value was low during the initial storage period and increasing this value means that the quality was slightly decreased.

Solubility: It appears that the initial myofibrilar protein solubility was in the range of 81 to 94.50%, which gradually decreased with the advancement of storage. At the end of 80 days storage the solubility declined to the range of 48.40 to 65.80% with the highest value in M_5 and the lowest in M_2. It appears from the result that myofibrilar protein declined more rapidly in fresh meat M and fresh mince meat M_2 without any cryo-protectant compared to those of M_3 and M_5.

References

Rahman, M. S., 1992. Dairy Development in Bangladesh. Proceedings of Fourth National Conference, Bangladesh Animal Husbandry Association, 84-88.

FAO, (Food and Agriculture Organization of United Nations), 1997. Production Year Book, 50. Rome, Italy

Alam, J., 1995. Livestock resource of Bangladesh. Present Status and Future Potential, University Press Limited. Dhaka, Bangladesh

Sarma, J., L. N. Srikar and G. V. S. Reddy, 1994. Deteriorative changes in ice stored pink perch and oil sardine, The Indian Journal of Animal Sci., 12: 921-925.

Baowu, Wang, L. Yuoling and Subrarnanian Srinivasan, 1997. Beef heart surimi was prepared. J. Food Sci., 62: 939-945.

Szmanko, T., K.O. Honikel and K Hofmann, 1997. Changes in histological structure and physicochemical properties of raw, cured, smoked pork loins resulting from freezing near cryoscopic temperature. Food Science & Tech. Abstract. 29: 247

Jay, J. M., 1975. The effect of micro-organisms on meat proteins at low temperatures. American Chemical Society. Food Science and Technology Abstracts, 9: 38