IOSR Journal Of Environmental Science, Toxicology And Food Technology (IOSR-JESTFT)
e-ISSN: 2319-2402,p- ISSN: 2319-2399. Volume 5, Issue 3 (Jul. - Aug. 2013), PP 37-43
www.Iosrjournals.Org

Studies on Effect of Curing and Antioxidant Treatments on Shelf Life of Buffalo Meat under Refrigerated Conditions

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Abstract: *Study was conducted to evaluate effects of treatments with curing (curing solution containing Salt, Sugar and Sodium Nitrate) and curing combined with antioxidant (BHA 500ppm) at Storage temperature (0°C and -5°C) using packaging material (HDPE and LDPE bags) on shelf life attributes including pH, total plate count and sensory characteristics (colour, odour and texture) of buffalo meat. It was found Curing increasedthe pH of meat sample and also brought improvement in colour. Initially, pH and colour score of raw meat were 5.89 and 7.00 while those of cured meat were 6.05 and 7.67, respectively. It also reduces microbial population (log of TPC per g of raw meat and cured meat were 4.30 and 3.47, respectively.Curing combined with antioxidant treatment was considered best which improved pH, colour, texture (pH was 5.9 and score value of colour and texture were 7.67 and 7.67, respectively. The treated sample was superior in microbiological and sensory quality.*

Keywords: *Buffalo meat, Curing, BHA*

I. Introduction

Man has satisfied his hunger with the animal food from the earliest of times. The term meat refers to muscle of warm blooded terrestrial four legged animals, the chief being buffalos, cows, goat, and sheep. Meat also includes the glands and organs of these animals. Meat products include many of the by- products from animal slaughter such as animal gut used for sausage the fat from meat used in the manufacture of lard, gelatin, and others.

Buffalo meat has become, out of various type meats, a great importance in recent years because of domestic demands and its export potential, it contributes about 85% of total meat export from India and its production in India is nearly 50% of the world's production (Sahoo, 1997).India has largest livestock population in the world. It has about 98 million buffaloes, which is 57% of total population in the world. They contribute to 1.48 million metric tonnes of meat, amounting 24.54% of the total meat produced in the country (FAO, 2008).

Buffalo is the only potential animal that can boost meat industry in India. Buffalo meat is the major item of Indian meat export generating huge revenue in animal products sector. Buffalo meat is the healthiest meat among red meats known for human consumption because it is low in calories and cholesterol. It has almost 2-3 folds cost advantage over mutton and goat meat. In India, meat is consumed either in curry form with high spices or as processed meat products. Only 2% of the meat is processed in India (APEDA, 2008), the remaining meat is sold in fresh or frozen form. Despite vast resource of population and contribution of buffaloes to the total meat production in the country, their potential for utility in the processed meat sector is not completely exploited.India has largest bovine population in the world.Scientifically the term meat and meat products refer to the muscle of warm blooded terrestrial four legged animal viz. cattle sheep and pigs. It also includes the glands and organs of these animals in addition to many of the by-products of animal slaughter such as animal gut used for sausage casing, the fat from the meat used in manufacturing of lard, gelatin, and others.Meat contains 15 to 20% of proteins of outstanding nutritive value. The lean meat contains 20 to 22 per cent proteins.

Of the total nitrogen content of meat, approximately 95% is protein and 5% is aminoacids. The amino acid make-up of meat proteins is very good for the maintenance and growth of human tissues.

The fat content of meat varies from 5 to 40 percent with the type, breed and age of the animal. When the animal is well fed, fat deposits subcutaneously as a protective layer around the organs. Then it accumulates around and between muscles. Finally, fat penetrates between the muscle fibre bundles and this is known as "marbling". The lean portion of meat contains greater proportions of phospholipids (0.5 to 1.0 per cent), and these are located in the membranes of cell.

Carbohydrates are found only in very small quantities in meat. Two carbohydrates present in meat are glycogen and glucose. Meat is an excellent source of some vitamins of B complex and a good source of iron and phosphorus. Meat also contains sodium and potassium.Meatcontains the protein hydrolyzing enzymes, cathepsins, and these are responsible for the increased tenderness of meat during ageing. The colour of meat is due primarily to myoglobin. Haemoglobin also contributes to the colour of meat to some extent. The two main ingredients that must be used to cure meat are salt and nitrite. However, other substances can be added to

accelerate curing, stabilize colour, modify flavour, and reduce shrinkage during processing. Salt is the primary ingredient used in meat curing. Originally it served as a preservative by dehydration and osmotic pressure which inhibits bacterial growth. Salt still functions as a preservative in the "country style" cured meat product. The main function of salt in other cured products is to add flavour. However; even at low concentrations salt has some preservative action. Salt levels are dependent on consumer's taste, but a two to three percent concentration in the product is about right.

II. Materials and Methods

Buffalo meat was collected from the local meat shop. The animal was slaughtered according to the traditional halal method. Meat samples from round portions (comprising mostly semi-membranous, biceps and quadriceps muscles) of about 2 year aged male carcasses of good finish were obtained from meat shop within 3 hr. of slaughter. The meat chunks were packed in low density polyethylene (LDPE) bags and brought to the laboratory within 20 min. The temp of meat was 25 to 30^{o}C on arrival at laboratory.

Sample preparation:-Buffalo meat was evaluated soon after obtaining the sample.For other treatments, meatwas chilled at 0ºC±1°C and -5±1°C for different days. Meat samples were cut into cubes 100 g blocks of meat were assigned to control and different treatments.

Sample-1:Raw meat 1kg buffalo meat was divided into 4 pieces of 250 g each were packed in LDPE and HDPE bags of size 8×6 inches and stored at 0°C ± 1°C and -5°C ±1°C.

Sample-2:Cured meat 1kg of meat was weighed and divided into 4 equal pieces and curing solution was made using 80 gram of common salt, 20g sugar, 1.16g of potassium nitrate and 540 ml of distilled water, as suggested by Khordyles, (1991). The solution was thoroughly mixed to dissolve the ingredients. Curing was allowed for 48 hours at 4°C .Cured meat was packed in low-density polyethylene (LDPE) and high density polyethylene (HDPE) and kept at 0°C ±1°C and -5°C ±1°C to evaluate the shelf life of samples.

Sample-3: Curing and treated with Antioxidant 1kg of sample was taken and dipped in curing solution containing 500 ppm of Butylated Hydroxyl Anisole (BHT), and it was allowed to stay at 4°C for 48 hours. It was packed in LDPE and HDPE bags at 0°C ± 1°C and -5 ± 1°C temperatures.

Physio-chemical characteristicsMoisture, ash and fat content were determined according to AOAC 2000 methods. Protein content was determined as per (IS: 7219:1973): Kjeldhal Method, protein content was obtained by using the conversion factor of 6.25 and carbohydrate content by difference method, pH by pH meter,organolepticcharacteristics were evaluated after giving treatments, samples were packed in LDPE and HDPE bags and keptunder refrigerated storage temperatures for study of shelf life.

Microbial analysis:Test for total count was conducted before and after treatment (namely curing, curing with antioxidant) in all samples and at regular intervals during storage. Microbial quality is considered to be the most important attribute of shelf life of meat. Microbial population exceeding 108/g of meat sample was taken as unsafe for human consumption at which unpleasant odour in raw meat samples was observed (Ranken and Kill, 1993)

Sensory evaluation:Appearance, odour and overall acceptability were evaluated organoleptically for all samples based on 8 point hedonic scale wherein 8, extremely desirable and 1, extremely undesirable.

III. Results and Discussion

Proximate composition of Raw meat-The proximate Composition of raw buffalo meat was found to be Moisture content 70%, fat 10%, Protein 19% and ash content 1%.

Effect of treatment, storage Temperature and packaging material on pH, TPC, ofbuffalo Meat sample:

Raw meat sample: The samples stored at refrigerated conditions showed an increase in pH from 5.94 to 6 in HDPE. Initially pH increased due to the fact that the meat sample was undergoing the ripening process while a decreased trend was observed during further storage and reached to 5.91 in HDPE and 4.1 in LDPE, Fig. 1.

TPC Count: Initially log/g of TPC was 4.30, indicating the fresh meat condition. However, this count started increasing continuously during storage at 0 and -5°C as shown in figure 4. Total plate count of samples packed in HDPE and LDPE bags increased to 9.00 and 9.13, respectively at 0°C after 25 days of storage which at -5°C storage increased to 9.04 and 9.11 after 45 days of storage.

Cured meat sample: The samples were kept allowed in the solution for 48 hours at 4°C and then packed in LDPE and HDPE bags and kept under storage temperatures 0 ± 1°C and -5± 1°C. The pH was drastically increased due to curing to 6.05. After curing pH further increased to 6.25 during storage at 0°C for 5 days. Then pH began to fall continuously till the cured meat sample packed in HDPE bags reached to spoilage conditions. The sample had minimum value of pH 5.11 after 45 days of storage. Corresponding values for sample packed in LDPE were 6.25 and 5.05, respectively, Fig. 2.

*TPC Count:*Initially the logarithmic value of TPC of per gram was 3.47 in cured meat samples. During storage at 0 and -5°C the TPC began to increase continuously and the logarithmic value of TPC per gram for sample packed in HDPE bags increased to 8.91 and 9.04 (Fig. 5) for cured samples stored at 0 and -5°C, respectively.

Cured and antioxidant treated samples: Curing solution combined with antioxidant showed a little different effect on pH variation on treatment and during storage (Fig. 3). After taking out the sample from the curing combined with antioxidant, pH was 5.92. The pH of sample packed in HDPE further increased during storage at 0°C for 5 days to 6.14. The pH value was found to decrease onwards during storage and it reached minimum value 5.17. The corresponding values of pH for samples packed in PP bags were 6.07 and 5.03, respectively.

*TPC Count:*Initially logarithmic values of TPC per gram were 3.47. It was noticed that BHA did not have individual effect on microbial load and initial TPC was observed same as that in case of cured sample. During storage at 0°C logarithmic value of TPC started increasing continuously for samples packed in HDPE and LDPE bags until it reached 8.96 and 8.97, respectively.Fig. 6.

IV. Conclusion

Curing developed many positive effects and improved quality of raw meat. It was observed that curing improved the colour texture and odour in meat. It caused reduction in microbial population (logarithmic value of TPC per gram for HDPE packed sample reduced to 3.47 while the pH value was 4.30 for raw meat. A little increment in pH after curing was observed. Shelf lives of cured meat sample packed in HDPE were about 36 days at 0°C and 51 days at -5°C storage temperature.

Curing combined with antioxidant again had many positive effects on meat quality. It was found that there was improvement in pH, colour, texture and odour of meat sample. Though it did not show any significant effect on microbial population initially. But a marked effect of antioxidant was observed during the later period of storage. Antioxidants used prevented the lipid rancidity which otherwise would have led to the conversion of fat into simpler compounds rendering meat prone to microbial growth. Therefore, cured and antioxidant treated samples had more shelf life as compared to simply cured meat. These samples packed in HDPE bags started deteriorating after 41 days at 0°C and 61 days at -5°C.

V. Figures

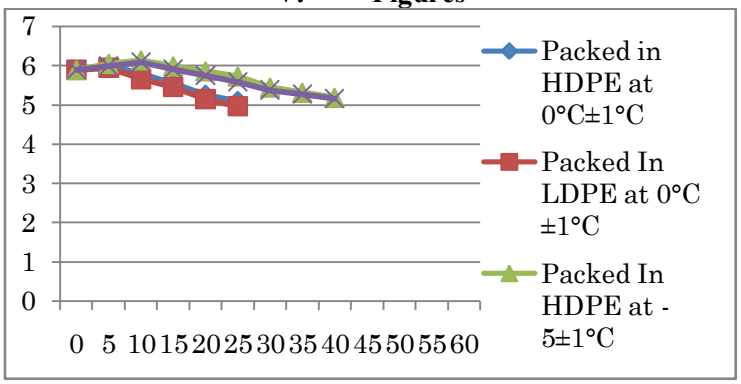

Fig.1. Effect of storage temperature on pH of raw meat samples packed in HDPE and LDPE bags.

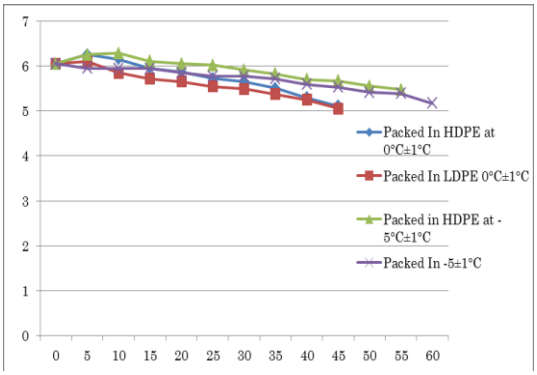

Fig. 2: Effect of storage temperature on pH of cured meat samples packed in HDPE and LDPE bags.

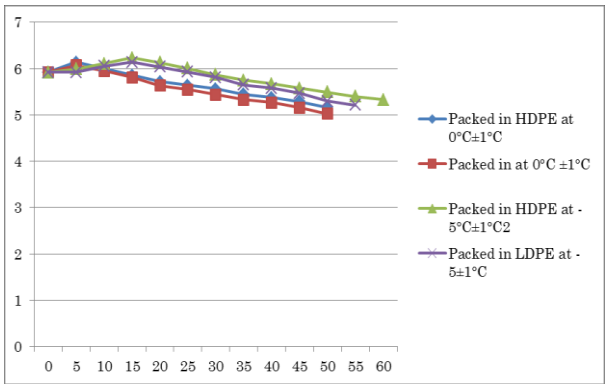

Fig. 3: Effect of storage temperatures on pH of Cured and Antioxidant treated meat samples packed in HDPE and LDPE bags.

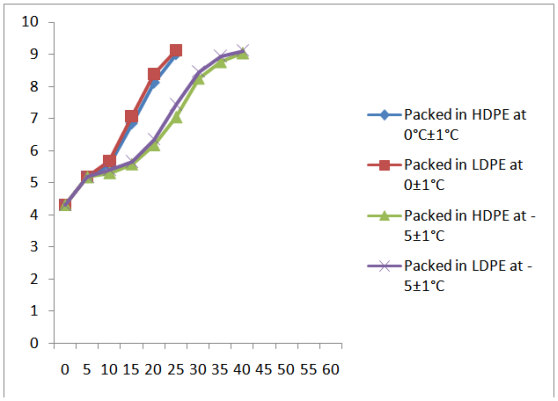

Fig.4: Effect of storage temperatures on TPC of raw meat samples packed in HDPE and LDPE bags.

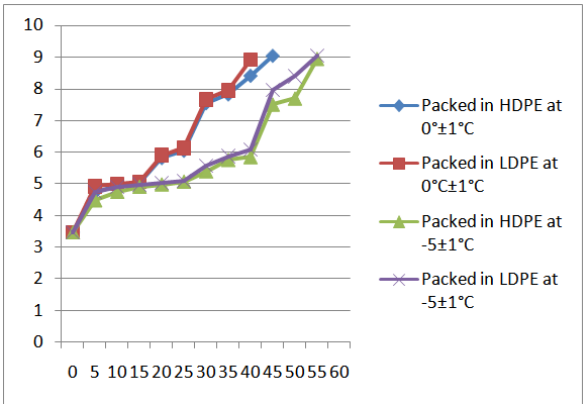

Fig.5: Effect of Storage Temperature on TPC of Cured meat samples packed in HDPE and LDPE bags.

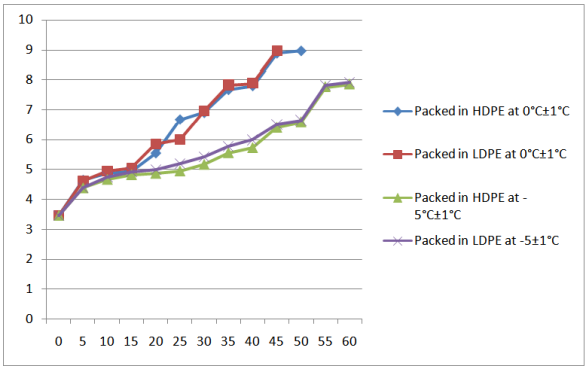

Fig 6: Effect of Storage Temperatures on TPC of Cured and Antioxidant Treated Meat Samples Packed in HDPE and LDPE bags.

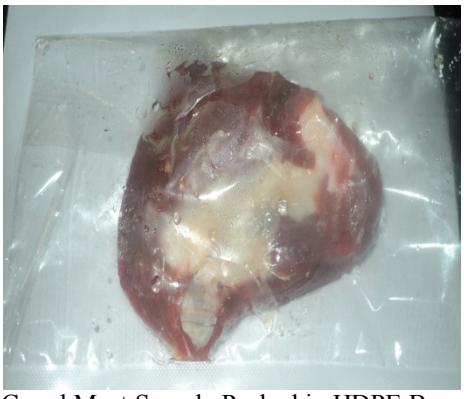

Fig.7. Cured Meat Sample Packed in HDPE Bag at 0°C

Fig. 8. Cured meat sample packed in LDPE at 0°C.

Fig. 9.Cured Meat Sample Packed in LDPE Bag at-5°C.

Fig.10. Cured and Antioxidant Treated Meat Sample Packed in HDPE Bag at 0°C.

Fig.11. Cured and Antioxidant Treated Meat Sample Packed in LDPE Bag at 0°C.

Fig. 12.Cured and Antioxidant Treated Meat Sample Packed in HDPE Bag at -5°C.

Table 1: Effect Of Treatments On Sensory Characteristics Of Buffalo Meat Packed In Hdpe And Ldpe Bags During Refrigeration Storage At 0°C And -5°C

REFRIGERATION TEMPERATURE	0°C			-5°C	
Sample packed in		HDPE BAGS	LDPE BAGS	HDPE BAGS	LDPE BAGS
Sensory attributes		RAW MEAT			
Number of Days	0(Initial)	25(Final)	25(Final)	35(Final)	35(Final)
Colour	7.00	4.33	4.00	4.33	4.33
Texture	7.67	3.00	3.00	3.67	3.67
Odour	7.67	2.67	2.33	3.67	3.78
		CURED MEAT			
Number of Days	0(Initial)	40(Final)	40(Final)	55(Final)	50(Final)
Sensory Attributes					
Colour	7.67	3.67	3.67	4.00	3.67
Texture	7.67	4.00	3.67	4.00	4.00
Odour	7.33	3.67	3.33	3.50	3.33
Overall acceptability	7.56	3.78	3.56	3.83	3.67
		CURED + SA TREATED MEAT			
Number of Days	0(Initial)	50(Final)	45(Final)	70(Final)	70(Final)
Sensory Attributes					
Colour	7.67	4.00	3.50	3.67	3.33
Texture	7.67	4.00	4.00	3.67	3.67
Odour	7.33	3.67	3.50	3.33	3.33
Overall Acceptability	7.56	3.89	3.67	3.56	3.33

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