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Studies on Physicochemical Properties of Cooked Buffalo Meat Sausage as Influenced by Incorporation of Carrot Powder during Refrigerated Storage

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Abstract

The studies were conducted for the development, quality evaluation and shelf life of cooked buffalo meat sausage samples prepared with different levels of fat (20-30%) and carrot powder (0-5%). The research work was designed by response surface methodology and therefore the range of two independent parameters viz. fat (20-30%) and carrot powder (0-5%) was selected. The quality of sausage samples was evaluated on the basis of physicochemical characteristics like, moisture content, ash content, fat content, protein content, pH value, and TBA number. The samples were packed in combination film and stored under refrigerated condition (0ºC) and for shelf life studies quality and analysis of sausage samples was carried out after every five days till the end of shelf life. The moisture content in the samples was observed in the range of 61.14 to 62.35% in fresh condition and it observed less decrement in the moisture content in samples having zero or low amount of carrot powder comparatively with the samples having higher amount of carrot powder during the refrigeration storage period. The ash content was observed in the range of 1.9 to 2.3% in fresh condition and slight increment in ash content was observed due to reduction in the moisture content during storage. Similarly fat content was found 14.12 to 16.67% in fresh condition, while an increase in fat content was found in sausage samples during refrigerated storage (0ºC). It was due to the decrease in the moisture content of sausage samples. The protein content of all sausage samples was found in the range of 18.37 to 18.70% in fresh condition. The increase in protein content was found due to similar reason of decrease in moisture content. The pH values of the sausage samples were found in the range of 6.132 - 6.412 in fresh condition and it was found that sausage sample having 21.46% fat content and 4.27% carrot powder had lowest decrement in the pH. The sausage samples found spoiled at TBA no. ≥ 0.20 and shelf life cooked buffalo meat sausage found of Twenty-one days under refrigerated condition.

Keywords: Buffalo meat; Carrot powder; Fat; Shelf life

Introduction

Buffalo (*Bubalus bubalis*) meat is a good source of Protein, vitamins B6 and B12, iron, potassium and even calcium. It has a higher content of vitamins and minerals that contribute to the stronger flavour. Meat is deprived of dietary fibre which causes several gastro-intestinal problems in human beings. Cooked buffalo meat sausage is incorporated with carrot powder to fulfil dietary requirement of buffalo meat. The food rich in dietary fibre affects the metabolic rate and the results have been observed which advocate the prevention of diabetes [1]. The resistant starches as well as non-digestible oligosaccharides are the basic classes of dietary fibres [2]. It has been observed that dietary fibre intake is inversely associated with aggressive prostate cancer among African Americans and European Americans [3]. Increasing consumption of dietary fibre rich diet will help to reduce the problem of obesity in developed countries [4]. Several physicochemical parameters have been studied to evaluate the quality and shelf life of cooked buffalo meat sausage. Meat is the ultimate source of protein, vitamins and minerals which are necessary for the growth of each and every individual. There are many animals which are continuously being used for the production of meat for instance poultry, buffalo, mutton, pig etc. Buffalo meat is used at large scale for the production of various buffalo meat processed product including sausages [5]. India has 50% share in buffalo meat production in the world. It indicates that India has plenty of buffalo meat as a raw material which can further be used for the preparation of several other processed meat products, i.e. sausage. People generally suffer with several gastrointestinal diseases which are basically due to fibre free diet. Meat, milk, egg and fish do not have dietary fibre that's why they cause gastrointestinal diseases when taken in pure form for a long period. In this research, a meat product is made with incorporating carrot powder. Carrot powder (*Daucus carota* Linn.) contains higher percentage of beta-carotene which is the Precursor of vitamin A i.e. 989 µg/g in fresh condition [6] as compare to other vegetables along with good source of dietary fibres. The dehydration of vegetables (carrot, broccoli and spinach) significantly reduces carotene but cooking did not affect carotene content [7]. After one week storage of carrot at room temperature, it was observed the highest retention of beta carotene in carrot i.e. 14000 µg/100 g [8]. Cooked buffalo meat sausage is prepared with meat, carrot powder, spices and condiments. It has been claimed that beta-carotene retention was found better in three minutes blanched samples than five minutes blanched samples [9]. The children of developing countries are suffering from various vitamin A deficiency disorder cause death of children every year [10]. The world population is at the risk of vitamin-A deficiency. The bioavailability of vitamin-A is higher in processed food than the raw material [11]. It has been found that pasteurization and sterilization at 121ºC caused only minor isomerisation of beta-carotene while sterilization at 130ºC and blanching caused higher isomerisation of beta-carotene and resulted in increased levels of cis-isomers [12]. Three bakery products incorporated with beta-carotene and tested against the losses in carotene and the losses were found as 20% in bagels and cake while 30% in cookies after baking [13]. While working with buffalo nuggets it has been found that on increasing the comminution temperature cooking losses and TBARS value increases [14]. The pH of Dietary Fibre supplemented fermented sausage was critically affected during ripening by the amount of Dietary Fibre incorporated, the values for sobrassada samples containing over

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3% of Dietary Fibre suggested that the fermentation process in these samples was not successful [15]. Dietary fibre is very important for today's diet due to increasing problems of constipation, type-2 diabetes mellitus, colon cancer and cardiovascular diseases along with several other gastro-intestinal problems [16]. In the study the main objectives were to analyse the physicochemical characteristics viz. moisture content, ash content, fat content, protein content, pH value and TBA number during refrigerated storage period at an interval of five days till the end of shelf life.

Materials and Methods

The Meat samples (collected from local meat shop for the study) were from buffaloes slaughtered according to traditional halal method at slaughterhouse of municipal corporation, Aligarh. The animals were kept in lariage for a period of 18-20 hrs before slaughter. Meat samples from round portion (biceps femoris muscle) of 2.5, 3 and 3.5 yrs aged female carcasses of good finish, were obtained from meat shop within 3-4 hrs of slaughter. Buffalo fat from brisket and back collected along with other meat ingredients. The meat chunks and buffalo fat were packed in low density poly ethylene (LDPE) and brought to the laboratory within 20-30 minutes other non meat ingredients like spices, condiments , salts and carrot were procured from the local market. The casing material was procured from PRS technologies New Delhi. The meat firstly washed with tap water then deboning taken place. After it, minced the meat and mixed with carrot powder, spices and condiments along with preservative. Finally filled into polymer casing and stored at refrigerated temperature in combination film. The white fat was taken 20-30 percent while carrot powder was taken in the range of 0-5 percent. Initially sausage samples were optimized by response surface methodology then according to the solution given by RSM software further storage study was conducted under refrigerated condition periodically after every five days till the end of shelf life.

Evaluation of Physicochemical Properties

Moisture content and ash content were determined by oven drying the methods [17]. The fat content was measured with the help of soxhlet apparatus. The pH value of sausage samples were measured by digital pH meter (Khera model, India). Protein content was determined by Biuret Protein Assay which is most common, simplest and very sensitive method. TBA number was measured with the help of spectrophotometer (digital spectrophotometer model 310E, India) by titrating sausage samples with several other chemicals (TBA reagent was prepared according to Pearson, 1973).

Statistical analysis

The experimental data were subjected to analysis of variance (Two way ANOVA). All statistical analysis were performed using SPSS Version 10.0 for windows (SPSS Inc., Chicago, IL, USA) as described by field [18].

Results and Discussion

Effect on moisture content

The moisture content is the important constituent of cooked buffalo meat sausage and it is one of its physicochemical characteristics which decide the important sensory attributes like juiciness of sausage samples. Water also greatly affects the texture of foods, as can be seen when comparing grapes and raisins (dried grapes), or fresh and wilted lettuce [19]. It is also indicative of the shelf life of the product. The results of moisture contents of different samples of cooked buffalo meat sausages have been presented in Table 1. Total nine samples of sausages (including one control) had moisture contents in the range of 61.14 to 62.35% in fresh condition (Table 1). The incorporation of carrot powder did not significantly affect ($p>0.05$) moisture content of cooked buffalo meat sausage. The control sample had 62.35% moisture content while sausage sample with 5% carrot powder was found to have 61.63% moisture content. The variation in moisture contents among the fresh samples was due to different levels of carrot powder incorporated. Generally samples with comparatively higher carrot powder showed lower values of moisture content due to low moisture content of carrot powder. Further the sausage samples were stored for a period of 30 days under refrigerated condition (0°C) and the analysis was carried out after every 5 days till the end of shelf life. During storage, the moisture content of the sample with 5% carrot powder was found to decrease from 61.63% to 53.34% as compared to 61.50 to 55.76% in control sample (Table 1). The water holding capacity (WHC) of meat is higher as compared to water holding capacity of vegetables due to strong association of water molecule with Porphyrin ring in meat [19]. The regression analysis shows that moisture content of the different samples was found to decrease continuously during storage period (Figure 1). The fact was that the presence of dietary fibers in the carrot powder reduced the moisture content by absorbing the water which was no more available to the meat for the proper hydrophilic bonding, required for the compaction of the sausage.

Effect on Ash content

The ash content of any food material shows its mineral matter i.e micro and macronutrients. The cooked buffalo meat sausage samples had ash content in the range of 2.3% (highest) in the sample with 5%

Sample code	Storage period (No. of days)						
	0th	5th	10th	15th	20th	25th	30th
CS 1	61.14	60.50	58.20	57.72	56.20	55.50	53.24
CS 2	61.50	60.30	60.42	59.28	57.60	55.32	53.67
CS 3	61.65	60.02	58.28	56.34	55.10	53.21	52.04
CS 4	62.35	62.20	62.10	61.76	59.38	57.46	55.76
CS 5	62.04	61.45	60.78	59.26	57.76	55.43	53.54
CS 6	61.87	60.24	59.02	57.86	56.13	55.23	53.22
CS 7	61.90	60.78	59.32	58.04	57.54	55.32	54.12
CS 8	62.12	61.33	60.24	59.22	58.35	57.56	55.24
CS 9	61.63	60.46	59.35	58.14	56.44	55.21	53.34

CS- cooked sausage (buffalo meat sausage)

1, 5 → 4.27% C.P 2, 6, 7 → 2.5% C.P 3, 8 → 0.73% C.P, 9 → 5% C.P, 4 → 0.0% C.P, 1, 3 → 28.54% W.F 4, 6, 9 → 25% W.F, 5, 8 → 21.46% W.F, 2 → 30% W.F, 7 → 20% W.F (C.P—Carrot powder, W.F—White fat)

Table 1: Evaluation of moisture content of cooked buffalo meat sausage prepared by taking different levels of fat and carrot powder during refrigerated storage (0°C).

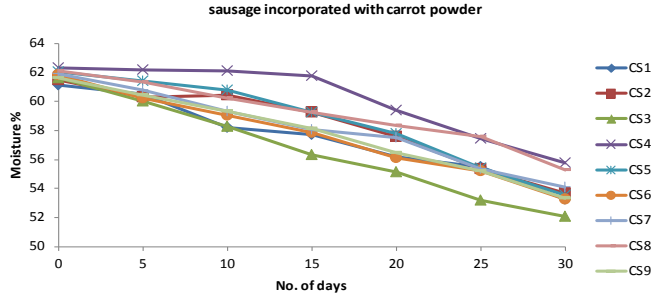

Figure 1: Regression analysis of moisture content of cooked buffalo meat sausage incorporated with carrot powder during refrigerated storage at 0°C.

carrot powder to 1.9% (lowest) in the sample without carrot powder in fresh condition as represented in the Table 2. The sausage samples with comparatively higher level of carrot powder had larger values of ash content. The ash content of remaining samples was found in between 1.9-2.3%. The carrot powder did not significantly ($p>0.05$) affect the ash content of cooked buffalo meat sausage (Figure 2). Further the study conducted to evaluate the change in the ash content of buffalo meat cooked sausage under refrigerated storage. It is clear from the results that ash content did not increase in an absolute manner but an apparent increase in the ash content with respect to moisture content was observed in the sausage samples due to successive reduction in the moisture content till the end of shelf life, as represented in Table 2. The positive value of slope explained the increment in the ash content during storage period. The correlation coefficient explains the correlation between ash content and storage days. The increasing nature of ash content with storage period was perfect at $R^2=1$. The values of R^2 for all the samples were found near to one which shows that correlation is almost perfect and the graphs may be approximated to straight line.

Effect on pH value

The pH value is the important physicochemical characteristic to decide the quality and shelf life of cooked buffalo meat sausage developed by incorporating different levels of buffalo white fat and carrot powder. Total nine sausage samples (including one control) had pH values in the range of 6.132 to 6.412 in fresh condition (Table 3). The control sample was found to have pH value 6.325 and sausage sample with 5% carrot powder had pH value 6.412. The incorporation of carrot powder did not significantly ($p<0.05$) affect pH value of sausage samples. The cooked buffalo meat sausage samples were incorporated with different levels of buffalo white fat also along with carrot powder due to which the sausage samples had comparatively higher pH values because of neutral nature of buffalo white fat. Further the storage study was conducted till the end of shelf life of product under refrigerated condition (0°C) and the analysis was carried out after every five days till the end of shelf life. During storage, the sausage samples were found to have variation in the pH values among sausage samples due to presence of different levels of carotene imparted by incorporating carrot powder which basically impart different levels of carotene content to the sausage samples. The pH values of sausage samples were evaluated before and during the refrigerated storage (0°C). Sodium ascorbate (500 ppm) was added as a natural preservative to check the oxidative deterioration of meat fat i.e. to check undesirable fall in pH value [20]. Sausage sample with 21.46% fat content and 4.27% carrot powder show less reduction in the pH value among all the nine samples including control. Generally, the samples having higher amount of carrot powder show less reduction in the pH value than the samples having lower amount of carrot powder due to presence of several carotenoids (antioxidant compounds) in carrot i.e. beta carotene(major carotenoid) which block the oxidation of fat into fatty acids. The correlation coefficient values explain the correlation between pH value and storage period. The decreasing nature of pH with storage period was perfect at $R^2=1$. The values of R^2 for all the samples were found near to one which shows that correlation is almost perfect and the graphs may be approximated to straight line. The samples CS2, CS6, CS7, CS8, and CS9 show more accuracy in the regression analysis i.e. having R^2 value close to unity (Figure 3). Many researchers show significant effect of vegetable or dietary fibre addition on meat products with less decreasing effect on pH value compare to control samples during storage period while Show no significant effect of vegetable (carrot, radish, capsicum) addition observed on pH value while working with mutton nuggets.

Effect on thiobarbituric acid (TBA) number

Thiobarbituric acid (TBA) number is important relevant characteristics of meat product that indicates the degree of fat oxidation state and later on stage rancidity of the cooked buffalo meat sausages. The cooked buffalo meat sausages after preparation were packed in combination film under atmospheric packaging systems. The sausage samples contained sufficient fat and therefore samples might be oxidized by atmospheric oxygen and may lead to develop warm over flavor (WOF). The cooked buffalo meat sausage developed

Sample code	Storage period (No. of days)						
	0th	5th I	10th	15th	20th	25th	30th
CS 1	2.20	2.34	2.44	2.56	2.62	2.73	2.80
CS 2	2.05	2.10	2.15	2.25	2.34	2.52	2.63
CS 3	2.12	2.22	2.36	2.28	2.44	2.50	2.59
CS 4	1.90	2.03	2.25	2.15	2.30	2.45	2.56
CS 5	2.12	2.22	2.30	2.47	2.45	2.63	2.80
CS 6	2.10	2.22	2.28	2.44	2.40	2.45	2.57
CS 7	1.98	2.07	2.15	2.23	2.34	2.49	2.65
CS 8	2.04	2.17	2.22	2.33	2.36	2.53	2.78
CS 9	2.30	2.32	2.40	2.39	2.53	2.58	2.69

CS- cooked sausage (buffalo meat sausage)

1, 5 → 4.27% C.P 2, 6, 7 → 2.5% C.P 3, 8 → 0.73% C.P, 9 → 5% C.P, 4 → 0.0% C.P, 1, 3 → 28.54% W.F 4, 6, 9 → 25% W.F, 5, 8 → 21.46% W.F, 2 → 30% W.F, 7 → 20% W.F (C.P—Carrot powder, W.F—White fat)

Table 2: Evaluation of ash content of cooked buffalo meat sausage prepared by taking different levels of fat and carrot powder during refrigerated storage (0°C).

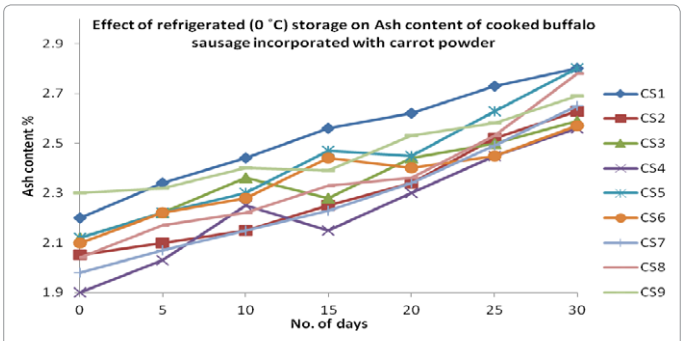

Figure 2: Regression analysis of ash content of cooked buffalo meat sausage incorporated with carrot powder during refrigerated storage at 0°C.

Sample code	Storage period (No. of days)						
	0th	5th	10th	15th	20th	25th	30th
CS 1	6.302	6.288	6.102	6.013	5.997	5.987	5.90
CS 2	6.382	6.310	6.205	6.131	6.051	5.981	5.902
CS 3	6.132	6.276	6.241	6.180	6.150	6.102	5.982
CS 4	6.325	6.276	6.198	6.091	5.983	5.878	5.721
CS 5	6.322	6.271	6.220	6.118	6.103	6.083	6.035
CS 6	6.356	6.261	6.201	6.125	6.023	5.924	5.892
CS 7	6.363	6.258	6.180	6.076	5.983	5.865	5.793
CS 8	6.281	6.203	6.135	6.060	5.964	5.887	5.803
CS 9	6.412	6.331	6.243	6.171	6.082	6.010	5.893

CS- cooked sausage (buffalo meat sausage)

1, 5 → 4.27% C.P 2, 6, 7 → 2.5% C.P 3, 8 → 0.73% C.P, 9 → 5% C.P, 4 → 0.0% C.P, 1, 3 → 28.54% W.F 4, 6, 9 → 25% W.F, 5, 8 → 21.46% W.F, 2 → 30% W.F, 7 → 20% W.F (C.P—Carrot powder, W.F—White fat)

Table 3: Evaluation of pH value of cooked buffalo meat sausage prepared by taking different levels of fat and carrot powder during refrigerated storage (0°C).

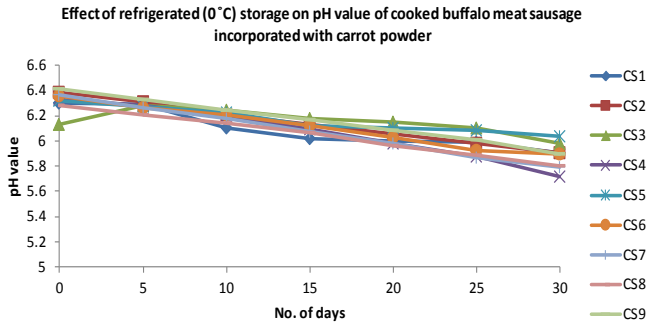

Figure 3: Regression analysis of pH value of cooked buffalo meat sausage incorporated with carrot powder during refrigerated storage at 0ºC.

Sample code	Storage period (No. of days)						
	0th	5th	10th	15th	20th	25th	30th
CS 1	0.115	0.125	0.138	0.158	0.169	0.195	0.205
CS 2	0.126	0.148	0.163	0.186	0.203	0.225	0.268
CS 3	0.129	0.150	0.168	0.187	0.210	0.243	0.270
CS 4	0.121	0.138	0.160	0.178	0.190	0.220	0.241
CS 5	0.093	0.104	0.120	0.129	0.143	0.161	0.176
CS 6	0.114	0.131	0.170	0.208	0.210	0.221	0.238
CS 7	0.120	0.131	0.147	0.158	0.170	0.191	0.208
CS 8	0.117	0.131	0.148	0.161	0.178	0.203	0.224
CS 9	0.132	0.152	0.180	0.210	0.228	0.253	0.283

CS- cooked sausage (buffalo meat sausage)
1, 5 → 4.27% C.P 2, 6, 7 → 2.5% C.P 3, 8 → 0.73% C.P, 9 → 5% C.P, 4 → 0.0% C.P, 1, 3 → 28.54% W.F 4, 6, 9 → 25% W.F, 5, 8 → 21.46% W.F, 2 → 30% W.F, 7 → 20% W.F (C.P—Carrot powder, W.F—White fat)

Table 4: Evaluation of TBA number of cooked buffalo meat sausage prepared by taking different levels of fat and carrot powder during refrigerated storage (0ºC).

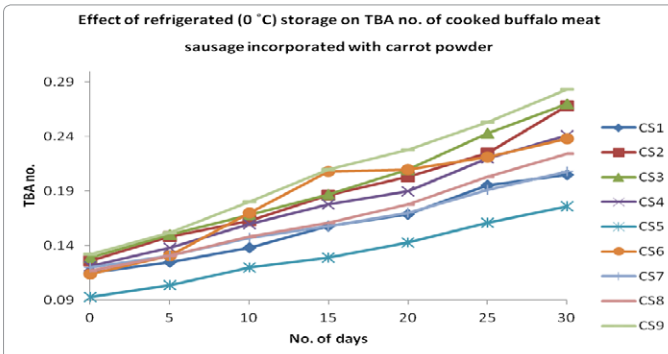

Figure 4: Regression analysis of TBA number of cooked buffalo meat sausage incorporated with carrot powder during refrigerated storage at 0ºC.

by incorporating different levels of buffalo white fat and carrot powder had thiobarbituric acid (TBA) number in the range of 0.093 to 0.132 in fresh condition (Table 4). The difference in values of TBA number was found due to different degree of fat oxidation in sausage samples. The incorporation of carrot powder did not significantly ($p<0.05$) affect the thiobarbituric acid (TBA) number of cooked buffalo meat sausage. Saturated fatty acids are less vulnerable to lipid peroxidation than their unsaturated counterparts [21]. Spectrophotometer used to determine the TBA number. Malondialdehyde (MDA) is the major degradation product of lipid hydroperoxides [22]. Higher TBA number indicates the higher fat oxidation which means the spoiled product. Generally, the sausage samples with higher carrot powder had lower values of TBA number as compare to the samples with low or negligible amount of carrot powder. The probable reason of this behaviour was found due to presence of antioxidants (β-carotene) component in carrot powder which reduced the degree of fat oxidation. The correlation coefficient values explain the correlation between TBA number and storage period (Figure 4). The Similar results have also been observed while working on buffalo meat loaves incorporating liver and vegetables (carrot and potato) by Suresh devatkal et al. It was found no significant effect of vegetable (carrot, radish, capsicum) on TBARS values while working with mutton nuggets.

Conclusion

The cooked buffalo meat sausage prepared by incorporating carrot powder improved the nutritional quality of the product due to presence of antioxidants (carotenoids) and dietary fibers in carrot powder. The carrot powder did not considerably affect the texture of the product. Though it had a little effect on moisture content of the product, it also did not create any hindrance in emulsion making. The product may help to sausage lovers to reduce the risk of constipation, cardio-vascular diseases, type-2 diabetes mellitus and colon cancer etc. the shelf life of the product was found to be twenty one days under refrigerated storage condition. The shelf life of the sausage was derived from TBA number of the product.

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References

1. Martin WO, Andreas PFH (2008) Metabolic Effects of Dietary Fiber Consumption and Prevention of Diabetes. J. Nutr 138: 439-442.
2. Champ M, Langkilde A, Brouns F, Kettlitz B, Collet YLB (2003) Advances in dietary fibre characterisation. 1. Definition of dietary fibre, physiological relevance, health benefits and analytical aspects. J. Nutrition Research Reviews 16: 71-82.
3. Tabung F, Steck SE, Joseph Su L, Mohler JL, Fontham ETH, et al. (2012) Intake of Grains and Dietary Fiber and Prostate Cancer Aggressiveness by Race. Prostate Cancer, Hindawi Publishing Corporation, Cairo, Egypt.
4. Salvin JL (2005) Dietary fibre and body weight. Nutrition 21: 411-418.
5. Sachindra NM, Sakhare PZ, Yashoda KP, Narasimha Rao (2005) Microbial profile of buffalo sausage during processing and storage. Journal of Food Control 16: 31-35.
6. Mendiratta SK, Shinde AT, Mane BG (2013) Effect of added vegetable (carrot, radish and capsicum) as functional ingredients in mutton nuggets. Journal of Meat Science and Technology 1: 71-76.
7. Park YW (1987) Effect of freezing, thawing, drying and cooking on carotene retention in carrots, broccoli and spinach. Journal of food science 52: 1022-1025.
8. Anjum F, Khan BA, Noreen N, Masoodm T, Faisal S (2008) Effect of Boiling and Storage on Beta-Carotene Content of Different Vegetables. Pakistan Journal of Life and Social Sciences 6: 63-67.
9. Dutta D, Raychaudhuri U, Chakraborty R (2005) Retention of β-carotene in frozen carrots under varying conditions of temperature and time of storage. African Journal of Biotechnology 4: 102-103.
10. Humphrey JH, West Jr KP, Sommer A (1992) Vitamin A deficiency and attributable mortality among under-5-year-olds. Bulletin of the World Organization 70: 225-232.
11. Rock CL, Lovalvo LJ, Emenhiser CT, Ruffin MT, Flatt SW, et al. (1998) Bioavailability of Beta-Carotene Is Lower in Raw than in Processed Carrots and Spinach in Women. J. Nutr 128: 913-916.
12. Marx M, Stuparic M, Schieber A, Carle R (2003) Effects of thermal processing on trans–cis-isomerization of b-carotene in carrot juices and carotene-containing preparations. Journal of food chemistry 83: 609-617.

13. Rogers DE, Malouf RB, Langemeier J, Gelroth JA, Ranhotra GS (1993) Stability and nutrient contribution of beta-carotene added to selected bakery products. Journal of cereal chem 70: 558-561.

14. Thomas R, Anjaneyulu ASR, Gadekar YP, Pragati H, et al. (2007) Effect of comminution temperature on the quality and shelf life of buffalo meat nuggets. Journal of Food Chemistry 103: 787-794.

15. Eim SV, Simal S, Rossello C, Femenia A (2008) Effects of addition of carrot dietary fibre on the ripening process of a dry fermented sausage (sobrassada). Journal of meat science 80: 173-182.

16. Yangilar F (2013) The Application of Dietary Fibre in Food Industry: Structural Features, Effects on Health and Definition, Obtaining and Analysis of Dietary Fibre: A Review. Journal of Food and Nutrition Research 1: 13-23.

17. Field A (2005) Discovering statistics using SPSS. (2nd edn) SAGE pubications, India.

18. Ranganna S (1994) Handbook of Analysis and Quality control for fruit and vegetable products. (2nd edn) Tata McGraw-Hill Publishing company limited, New Delhi, India.

19. Vickie AV Elizabeth WC (2008) Water: Essentials of food science. (Third Edn) Springer, New york, USA.

20. Sahoo J, Anjaneyulu AS (1997) Quality Improvement of Ground Buffalo Meat by Preblending with Sodium Ascorbate. Journal of Meat Science 46: 237-247.

21. Rael LT, Thomas WG, Craun ML, Curtis CG, Bar-Or R, et al. (2004) Lipid Peroxidation and the Thiobarbituric Acid Assay: Standardization of the Assay When Using Saturated and Unsaturated Fatty Acids. Journal of Biochemistry and Molecular Biology 37: 749-752.

22. Raharjo S, Sofos JN (1993) Methodology for measuring Malonaldehyde as a product of lipid Peroxidation in muscle Tissue: A Review. Meat Sci 35: 145-169.

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