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Quality Evaluation of Traditional Organ Meat Product Bhutwa of Uttarakhand Containing Natural Antioxidants: An Approach Towards Goat Byproducts Value Addition

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Abstract

Present investigation was envisaged to standardize the method of preparation as well as ingredient formulation of traditional organ/variety meat product of Uttarakhand. Investigation also evaluates the antioxidant and antimicrobial activities of test ingredients; tomato powder and green chili powder in the product which was added in order to enhance the shelf life of product without affecting its quality. Moisture, protein, fat, ash and cholesterol content of the product were 73.01%, 19.54%, 5.28%, 2.16% and 155.903mg/100gm respectively. Cooking yield of the product was found to be 70.048%. Tomato powder and green chili powder exerted antioxidant effect by significantly (P<0.05) reducing the TBARS, FFA and peroxide value as well as antimicrobial effect by significantly reducing (P<0.05) the microbial count of the treatments. A combination of these exerted highest (P<0.05) antioxidant as well as antimicrobial effects. Addition of treatments considerably enhanced the quality of the product along with enhancement of sensory acceptability.

Keywords: Meat by-product, Natural antioxidants, Organ Meat, Quality Evaluation

Introduction

Domestic goat *Capra hircus* is the most adaptable and geographically widespread livestock species, ranging from the high altitude of the Himalayas to the deserts of Rajasthan and humid coastal areas of India. Archaeological evidence indicates that goat was one of the first animals to be domesticated by humans around 10,000 years ago at the dawn of the Neolithic period in the Fertile Crescent (Porter 1996 and Pringle 1998). Goat is important livestock species of India and other developing countries. It provides a good source of meat, milk, fiber and skin. It is popularly known as the ‘‘poor man’s cow’’ (MacHugh and Bradley, 2001).

Goat farming is practiced worldwide, with goat products having a favorable image (Morand-Fehr *et al.,* 2004). The number of goats has increased globally, even in countries with high and intermediate incomes (Morand-Fehr *et al.,* 2004). Chevon is lower in cholesterol than rabbit, venison or beef. Saturated fat in goat meat is 40% less than that of chicken. It is 50-60 % lower in fat than similarly prepared beef but has the same or more protein content. The content and the amount of fatty acid saturation can affect the human health and the degree of fat firmness, which influences the value and acceptability of meat products (Perry *et al.,* 1998). Goat meat is lower in calories, total fat, saturated fat, and cholesterol than other meats. Less saturated fat and less cholesterol mean healthier red meat for the health-conscious consumer. Additionally, goat meat has higher levels of iron (3.2 mg) when compared to a similar serving size of beef (2.9 mg), pork (2.7 mg), lamb (1.4 mg), and chicken (1.5 mg) (Addrizzo, 2004).

Offals are called, especially in the United States, variety meats or organ meats; this refers to the internal organs and entrails of a butchered animal. The word does not refer to a particular list of edible organs, which varies by culture and region, but includes most internal organs other than muscle and bone. In some parts of Europe, scrotum, brain, chitterlings (pig's small intestine), trotters (feet), heart, head (of pigs, calves, sheep and lamb), kidney, liver, spleen, "lights" (lung), sweetbreads (thymus or pancreas), fries (testicles), tongue, snout (nose), tripe (reticulum) and maws (stomach) from various mammals are commonly used as an organ meat product. Total edible (meat and some offal) and commercially valuable (meat and offal) portions of the carcass are important aspects of the economic value of goats for meat production (Devendra and Owen, 1983). Organ meats, whether from goat, beef, pork or poultry are rich in essential vitamins and minerals. Liver is an excellent source of high-quality protein; contains an abundance of vitamin A and several B vitamins and is an excellent source of folic acid, iron and copper.

Bhutwa, a traditional meat product of Uttarakhand, is a variety meat product, prepared with liver, intestine, lung, rumen, reticulum, omasum and abomasum of goat. Objectives of the present study were envisaged to standardize the formulation as well as processing methodology and to evaluate effect of natural antioxidants (tomato powder and green chili powder) on quality attributes of the product.

Materials and Method

Research was conducted in the department of Livestock Products Technology, College of Veterinary and Animal Science, GBPUA&T, Pantnagar. All the chemicals reagents for laboratory analysis to be used were of analytical grade and obtained from standard firms (Qualigen, Hi-Media, Sd-fine etc.). The culture media and their additives used in the study were procured from Hi-media Laboratories, Mumbai. Bhutwa was prepared according to the traditional method and ingredients were standardized on the basis of sensory evaluation using semi trained panel member of College of Veterinary & Animal sciences and on the basis of sensory scores obtained.

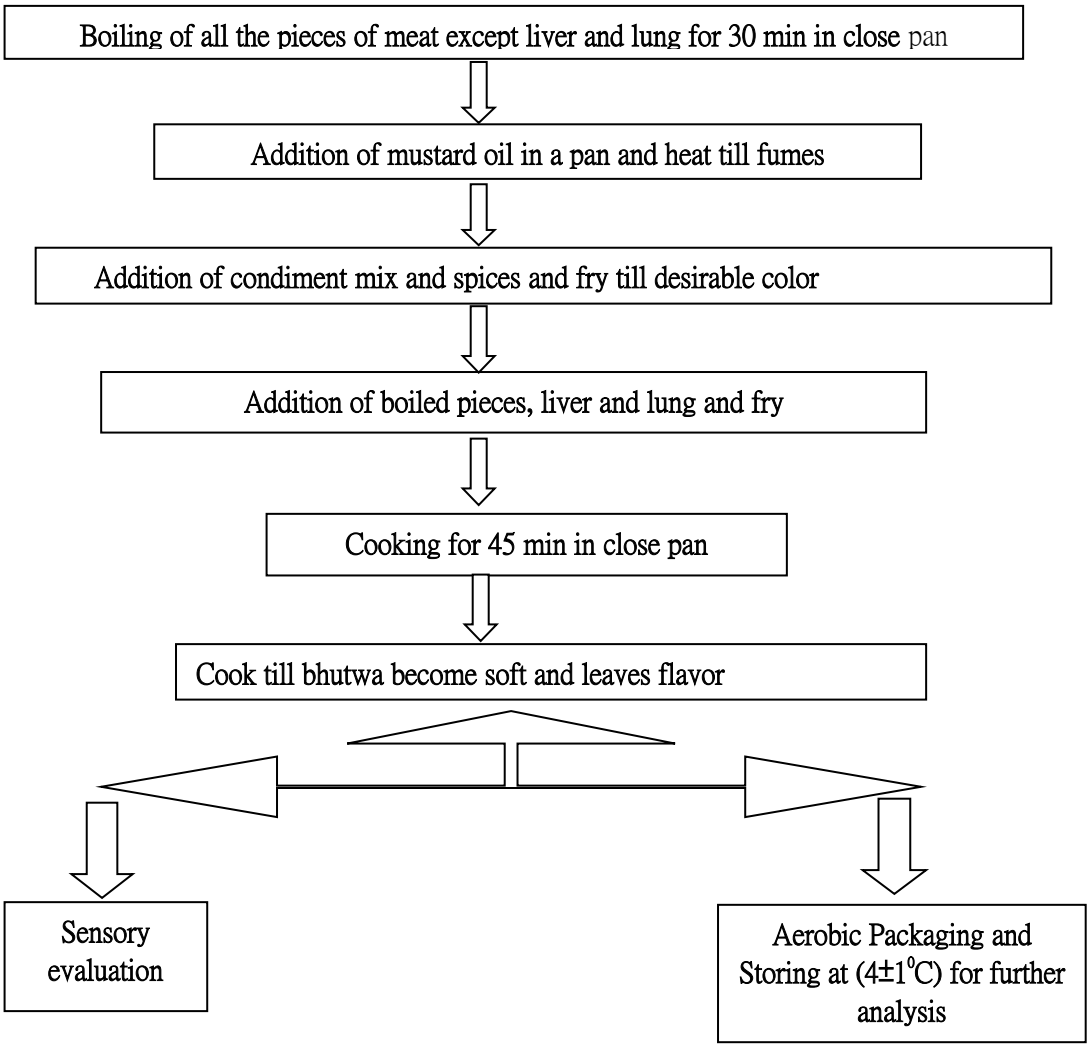
Table 1: Formulation of ingredients

Ingredients	Weight (gm)
Offals	70
Mustard oil	12
Spice mix	6
Condiments	10
STPP	0.2
Salt	2
Sodium Nitrite	150 ppm

Optimization of Concentration of Tomato Powder and Green Chilli Powder Functional Additives

Tomato powder was manufactured by the method of Jayathunge *et al.* (2012) and green chilli powder was prepared by method standardized in the laboratory by continuous oven drying at 55°C for 62 h followed by grinding. Based on sensory evaluation, series of optimizations trials were conducted to select a final concentration of incorporation that contained, 5% tomato powder, 2.5% green chilli powder.

Flow Chart of Preparation of Bhutwa



Bhutwa was packed aerobically in sterilized LDPE and stored at refrigerated temperature for further analysis. The samples (T (Tomato powder treatment), C (Chili powder treatment) and TC (Tomato powder+chilli powder treatment) of Bhutwa were analyzed for physico-chemical, microbiological and sensory characteristics at refrigeration temperature on 0, 4, 8 and 12th day of refrigerated storage (4±1°C).

Analytical Procedure

Proximate and Physic-Chemical Parameters

Proximate content was determined as per the method described by AOAC (1995). Cholesterol content was determined as per Zaltkis *et al.* (1953) with little modification as described by Rajkumar *et al.* (2004). pH was measured using the digital pH meter (Cyberscan, pH 510, Eutech Instruments, Singapore). Thiobarbituric acid value was estimated as per procedure given by Tarladgis *et al.* (1960). Peroxide value was estimated as per procedure given by AOAC (1998) and free fatty acid value was determined by modified AOAC method (Koniecko, 1979).

Microbiological Evaluation

Microbiological quality of treatment and control samples were analysed following the methods described by American Public Health Association APHA (1984). Plate count agar, Potato Dextrose Agar and violet red bile agar were respectively used for the standard plate count, yeast and mold count and coliforms count. Serial dilutions of the samples were made using sterile 0.1% peptone water and mixed uniformly to get dilutions 10^{-2}, 10^{-3} and so on. After inoculation by pour plate method, plates were kept for 72 h at 37°C for specific plate count, 25°C for 5 days for yeast and mold count and 35±2°C for 48 h for coliforms counts. Plates showing 30-300 colonies were counted. The number of colonies was multiplied by the reciprocal of the dilution and expressed as $\log_{10}$cfu/g.

Sensory Evaluation

Sensory attributes were evaluated using 8 point descriptive scale (Keeton *et al* 1983). Panelists consisting of 7 numbers of judges in each trial were make familiarized with the nature of the product without disclosing the identity of the product. Products were evaluated at ambient temperature and plain water was provided to rinse the mouth in between the sensory evaluation of samples.

Statistical Analysis

Each trial was replicated three times and each trials was performed in duplicate (n=6). The statistical analysis of the data was done through analysis of variance using SPSS-16.0 (SPSS Inc., Chicago, II USA) Software. Differences between means were considered significant when $P<0.05$. Duncan's multiple range tests were used to detect differences among mean values.

Results and Discussion

Product Profile Analysis

Sample showed mean moisture, protein, fat and ash 73.01%, 19.54%, 5.28% and 2.16 % respectively (Fig. 1). Park *et al.* (1991) also determined the moisture and total fat of goat liver, kidney, heart, Longissimus dorsi (LD) and Biceps femoris (BF) muscles and Mean moisture (%) and total fat (%) for the respective tissues were observed as 75.9, 3.26, 82.0, 3.14 79.2, 4.32, 79.2, 2.27 and 80.9, 2.0 respectively.

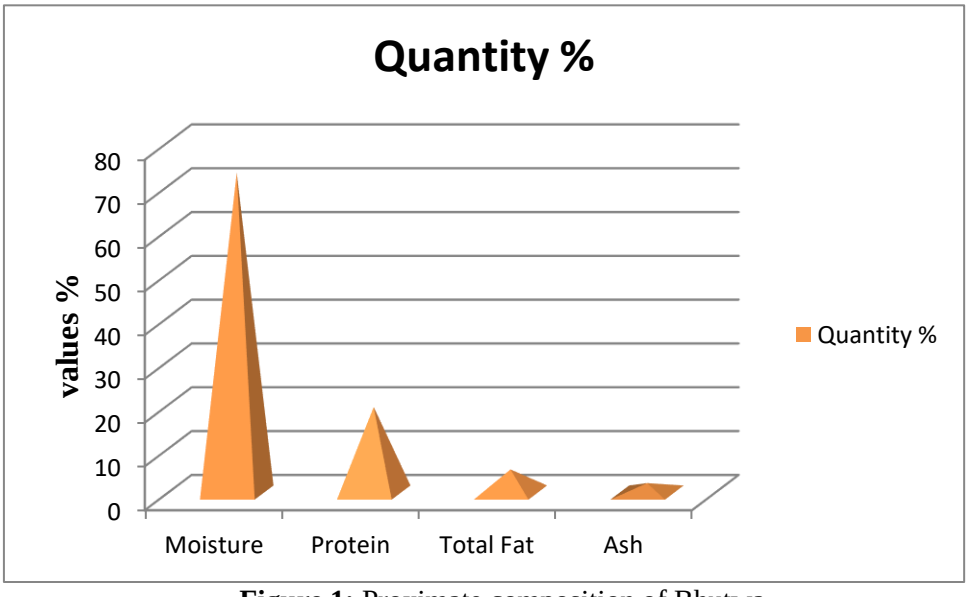


Figure 1: Proximate composition of Bhutwa

The sample showed mean cholesterol value 155.903mg/100gm. Findings of Madruga *et al.* (2001) suggested that cholesterol content of edible goat meat by-product ranges from 1700mg/kg to 1940 mg/kg, whereas, Park *et al.* (1991) determined the cholesterol of goat liver, kidney, heart, Longissimus dorsi (LD) and Biceps femoris (BF) muscles 219.2 mg/100gm, 276.7mg/100gm, 167.5mg/100gm, 57.8mg/100gm and 69.5 mg/100gm respectively.

Result of present study showed slightly lower cholesterol content of bhutwa as compared to that of Park *et al.* (1991) and Madruga *et al.* (2001). The sample showed mean cooking yield of 70.048%. Breidenstein and Williams (1987) reported that mass reduction can be 20 to 35% of which 70 to 80% is lipid cookout.

pH

pH values of control and treatment samples increased over storage period however rate was significantly higher ($P<0.05$) for the control product and lowest ($P<0.05$) for TC (Table 2). Increasing trend observed in pH during storage may be attributed to proteolysis, due to bacterial growth. Addition of T and C had significant ($P<0.05$) effect on pH of bhutwa. The overall mean pH of T was found to be lower as compare to TC, C. It might be due to acidic nature of tomato. However, non-significant difference was found among T, C & TC.

Table 2: pH values of Bhutwa during refrigeration storage

Storage days	Control (Con)	Tomato (T)	Green chilli (C)	Tomato +Green chilli (TC)	Days mean
0	6.455 ± 0.17^{Ac}	6.050 ± 0.20^{Bc}	6.446 ± 0.17^{Ab}	6.351 ± 0.17^{Ab}	6.325 ± 0.09^{W}
4	6.555 ± 0.14^{Ab}	6.143 ± 0.08^{Bc}	6.455 ± 0.16^{Bb}	6.281 ± 0.11^{Bb}	6.343 ± 0.06^{W}
8	6.860 ± 0.17^{Ab}	6.423 ± 0.24^{Bb}	6.680 ± 0.16^{Ba}	6.370 ± 0.09^{Cb}	6.583 ± 0.09^{X}
12	$7.253\pm0.23^{A\,a}$	6.758 ± 0.18^{Ba}	6.811 ± 0.16^{Ba}	$6.638\pm0.14^{C\,a}$	6.865 ± 0.09^{Y}
Treatment mean	6.765 ± 0.109^{N}	6.343 ± 0.105^{M}	6.598 ± 0.083^{M}	6.410 ± 0.069^{M}	

Means bearing different superscripts in each row denotes by small alphabets (a, b, c, d) and in each column by Capital alphabets (A, B, C, D) differ significantly (P<0.05).

Candogan and Deda (2002) also reported a decreased in the pH value of meat products containing 10-15% tomato paste. It may be attributed to the high concentration of tomato. Calvo *et al.* (2007) reported that 1.2% dry tomato peel added sausages has no significant influence on pH during 21 days storage. Martinez *et al.* (2006) observed no significant differences in pH values of control and Capsicum added sausages throughout the storage time at 20°C.

Evaluation of Antioxidant Effect

TBARS values of control and treatment samples increased over the storage period. Overall storage mean of TBA values increased significantly ($P<0.05$) from 0.409 ± 0.025 on day 0 to 1.369 ± 0.068 on day 12 (Table 3). It might be due to increase lipid oxidation and production of volatile metabolites in the presence of oxygen. On day 1 there was no significant difference among treatment but 8^{th} day onward highly significant ($P<0.05$) difference among treatments and control were observed which was lowest for TC sample.

Table 3: TBARS values of Bhutwa during refrigerated storage (Mean±S.E)

Storage days	Control (Con)	Tomato (T)	Green chilli (C)	Tomato + Green chilli (TC)	Days mean
0	0.488 ± 0.04^{Aa}	0.384 ± 0.05^{Aa}	0.042 ± 0.05^{Aa}	0.364 ± 0.05^{Aa}	0.040 ± 0.025^{W}
4	0.753 ± 0.05^{Ba}	0.690 ± 0.07^{Ba}	0.634 ± 0.08^{Ba}	0.618 ± 0.11^{Ba}	0.674 ± 0.038^{X}
8	1.118 ± 0.07^{Cb}	0.894 ± 0.05^{Ca}	0.884 ± 0.04^{Ca}	0.828 ± 0.06^{Ca}	0.931 ± 0.035^{Y}
12	1.779 ± 0.17^{Db}	1.304 ± 0.04^{Da}	1.286 ± 0.04^{Da}	1.106 ± 0.04^{Da}	1.369 ± 0.688^{Z}
Treatment mean	1.034 ± 0.11^{N}	0.818 ± 0.07^{M}	0.802 ± 0.07^{M}	0.729 ± 0.06^{M}	

Means bearing different superscripts in each row denotes by small alphabets (a, b, c, d) and in each column by Capital alphabets (A, B, C, D) differ significantly (P<0.05).

Addition of test ingredient as tomato, chilli and tomato+chilli resulted in delaying of lipid oxidation. It might be due to carotenoids and capsaicinoids content of chilli and tomato, excellent natural antioxidative agent which reduces lipid oxidation. Candogan (2002) also reported that tomato paste (5%, 10%, 15%) added beef patties had reduces the TBA value ($P<0.05$) over 9 days of storage period. Results of present study are in agreement with Martinez *et al.* (2006), Gok *et al.* (2012) and Escalante *et al.* (2003). Kim *et al.* (2016) observed. Thiobarbituric acid reactive substances (TBARS) values of raw pork patties containing oven dried tomato powder were lower than those of control.

Free Fatty Acid

Addition of T and C had significant (P<0.05) effect on FFA value of Bhutwa. Overall mean value for control was found to be significantly (P<0.05) higher as compared that of T, C and TC However non-significant difference was found among T, C & TC (Table 4). On day 0 there is no significant difference among treatments but 4th day onward significant (P<0.05) differences among treatments and control were observed.

Table 4: FFA values (% oleic acid) of Bhutwa during storage (Mean±S.E)

Storage days	Control (Con)	Tomato (T)	Green chilli (C)	Tomato +Green chili (TC)	Days mean
0	0.923 ± 0.01^{Ab}	0.7268 ± 0.01^{Aa}	0.715 ± 0.02^{Aa}	$0.618\pm.01^{Aa}$	0.745 ± 0.02^{W}
4	2.150 ± 0.01^{Bc}	1.2400 ± 0.06^{Bb}	1.150 ± 0.01^{Bb}	0.986 ± 0.03^{Ba}	1.381 ± 0.09^{X}
8	2.490 ± 0.05^{Cc}	1.7183 ± 0.01^{Cb}	1.708 ± 0.00^{Cb}	1.286 ± 0.02^{Ca}	1.800 ± 0.09^{X}
12	3.091 ± 0.07^{Dc}	2.4483 ± 0.02^{Dc}	2.210 ± 0.02^{Db}	1.691 ± 0.02^{Da}	2.360 ± 0.10^{Y}
Treatment mean	2.163 ± 0.16^{N}	1.533 ± 0.133^{M}	1.445 ± 0.11^{M}	1.145 ± 0.082^{M}	

Means bearing different superscripts in each row denotes by small alphabets (a, b, c, d) and in each column by Capital alphabets (A, B, C, D) differ significantly (P<0.05).

Antioxidant effects might be due to carotenoids of tomato and capsanthin of chilli which reduces lipid oxidation and free fatty acid formation. Olorunsanya *et al.* (2009) reported that addition of any species of Capsicum to ground pork meat effectively reduces lipid oxidation in raw or cooked patties compared to the control. Gupta *et al.* (2017) found a significantly lower FFA value in chicken meat cutlets incorporating Carrots and Oats as compare to control sample throughout storage.

Peroxide Value

Addition of T and C had significant (P<0.05) effect on peroxide value of meat. Overall mean value for control was found to be significantly (P<0.05) higher as compared to the overall mean values for T, C and TC. TC had significantly (P<0.05) lower value, when compared to T and C. However no significant difference was found between T and C (Table 5). Decrease in peroxide value might be due to their polyphenolic constituents which function as antioxidants by terminating free radical chain reaction.

Table 5: Peroxide values (milliequivalent peroxide/ kg sample) of Bhutwa during storage (Mean±S.E)

Storage days	Control (Con)	Tomato (T)	Green chilli (C)	Tomato + Green chilli (TC)	Days mean
0	2.040 ± 0.03^{Ad}	1.98 ± 0.04^{Bc}	1.96 ± 0.040^{Bd}	1.93 ± 0.04^{Bd}	1.98 ± 0.02^{W}
4	3.18 ± 0.21^{Ac}	2.71 ± 0.21^{Bb}	2.70 ± 0.21^{Bc}	2.10 ± 0.05^{Bc}	2.67 ± 0.11^{X}
8	3.98 ± 0.17^{Ab}	3.54 ± 0.34^{Ba}	3.60 ± 0.31^{Bb}	3.17 ± 0.04^{Cb}	3.576 ± 0.13^{Y}
12	5.788 ± 0.29^{Aa}	5.028 ± 0.31^{Ba}	5.063 ± 0.14^{Ba}	4.394 ± 0.23^{Ca}	5.068 ± 0.15^{Z}
Treatment mean	3.750 ± 0.299^{O}	3.318 ± 0.264^{N}	3.339 ± 0.258^{N}	2.902 ± 0.213^{M}	

Means bearing different superscripts in each row denotes by small alphabets (a, b, c, d) and in each column by Capital alphabets (A, B, C, D) differ significantly (P<0.05).

These antioxidative effects might be due to carotenoids and capsanthin which scavenges free radicals. Salem (2013) also reported antioxidative property of tomato peel in beef sausages during frozen storage. Results of present study are in agreement with the Ruanma (2010) who evaluated total phenolic content & antioxidative property of green chilli paste and found a highly effective antioxidative property of green chilli paste which reduces the lipid oxidation. Kim *et al.* (2013) also reported the antioxidant activity of oven-dried tomato powder (OTP) in pork patties.

Antimicrobial Effects

Total Plate Count

Addition of T and C had significant (P<0.05) effect on Total plate count of Bhutwa. Overall mean value for control was found to be significantly (P<0.05) higher as compared to the overall mean values for T, C and TC. Highly significant difference (P<0.05) was found among T, C and TC. TC had significantly (p<0.01) lower value as compare to T and C (Fig. 2). It might be due to lower pH and acidic nature of tomato and polyphenolic compound

of chili which prevent growth of microorganism.

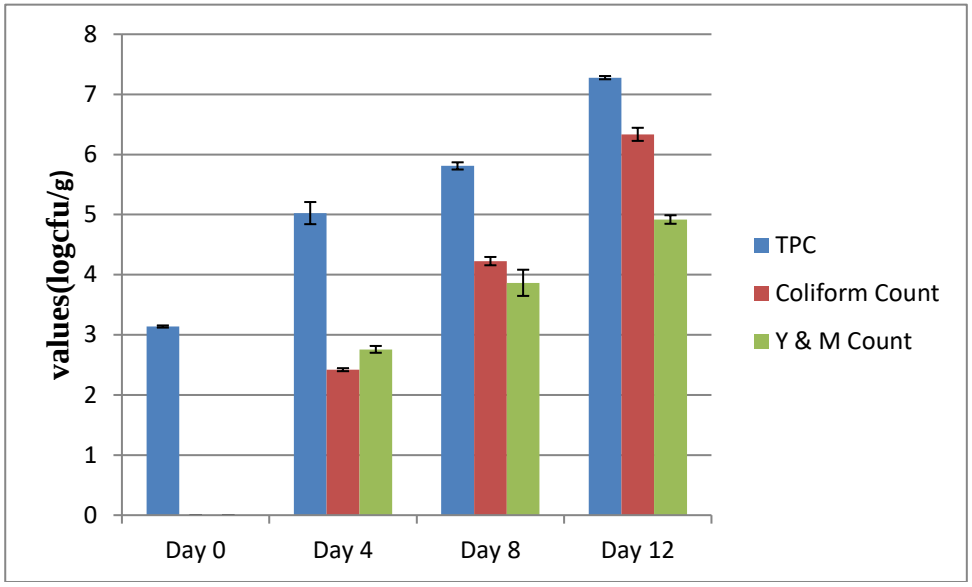


Fig. 2: Microbiological quality of Bhutwa during refrigeration storage

Salem (2013) observed that tomato peel added beef sausages has significantly (P<0.05) lower TPC when compared to control during frozen storage. Gok *et al.* (2012) also found that that TVC decreases with cooking process however increased significantly (P<0.05) during storage and no significant differences were determined among different treatment groups. SPC counts of tomato and red grapes powder added products throughout the storage period. Yeast and mould counts were not detected in all the products and control throughout the storage period (Najeeb *et al.* 2015) also reported lower TPC of restructured chicken slices. Lower total plate count of chicken meat spread added with tomato powder and essential oils were also observed by Arya *et al*. (2019).

Coliforms Count

Coliforms were not observed throughout the storage period. This was because of cooking of product to an internal temperature to not less than 90°C, which might have been lethal to the coliforms.

Yeast and Mould Count

The Y&M count of control and treatment samples increased over storage period. On day 1 there is no significant (P>0.05) difference among treatment and control but 4th day onward significant (P<0.05) difference among treatments and control were observed which was lowest for TC sample. Addition of T and C had significant (P<0.05) effect on Y&M count of Bhutwa. The overall mean value for control was 2.885±0.382 which was found to be significantly (P<0.05) higher as compared to the overall mean values for T, C and TC. (Fig. 2). It might be due to antimicrobial effect of chilli and tomato. Findings of Anandh *et al.* (2012) showed Y&M count 0.850±0.180 and 0.840±0.320 respectively for fried buffalo and goat tripe products. Bharti *et al.* observed lower Y&M count of chicken patties than control incorporated with lotus stem paste as functional and antimicrobial additive. Anand *et al.* (1992) observed yeast and mould counts of chicken products to be very low at the time of preparation of product but increased as high as 3.82log$_{10}$ cfu/ gm during refrigeration storage.

Sensory Attributes

Appearance and Color

Addition of T and C had significant (P<0.05) effect on scores of meat. Overall mean value for control was found to be significantly (P<0.05) lower as compared to the overall mean values for T, C and TC. T and TC had significantly (P<0.05) higher scores as compare to C. It might be due to addition of chilli and tomato which prevent the discoloration of Bhutwa. However, non-significant difference was found between T & TC (Fig. 3).

Modzelewska *et al.* (2012) reported that addition of tomato powder significantly increased the sensory score of the meatloaves. Calvo *et al* (2007) also observed significant differences (P<0.05) in color parameters between control and tomato peel enriched treatment sample. However, Arya *et al*. (2017) observed significantly enhanced color and appearance score of chicken meat spread added with tomato powder. Addition of T and C had significant (P<0.05) effect on flavor scores of Bhutwa. Overall mean value for control was found to be significantly (P<0.05) lower as compared to the overall mean values for T, C and TC. T and TC had significantly (P<0.05) higher scores as compare to C. However non-significant difference was found between T &TC (Fig. 3). Tarladgis *et al.* (1996) described that the progressive decrease in the flavor could be correlated to increase in TBA value of meat products stored under aerobic conditions. Addition of T and C had significant (P<0.05) effect on texture scores of meat. TC had significantly (P<0.05) higher scores as compare to T and C (Fig. 3). Findings of Doménech-Asensi *et al.* (2012) suggested no significant differences in textural parameter of mordetella, thus it can be stated that addition of tomato powder does not affect texture.

Addition of T and C had significant effect on juiciness scores of Bhutwa. Score for control were found to be significantly lower as compared to the overall mean values for T, C and TC. Mean scores of TC was found to be lower as compare to C and T. However non-significant difference (P>0.05) was found among T, C &TC (Fig. 3). Results of present study are in agreement with Gok *et al.* (2012). Candogan (2002) reported that tomato paste addition increased juiciness of beef patties as compare to control. Gok *et al.* (2012) reported doner kebab with added tomato has high juiciness score as compare to other group (P<.05). Salem (2013) also observed that tomato peel added beef sausages has significantly (P<.0.05) higher juiciness score.

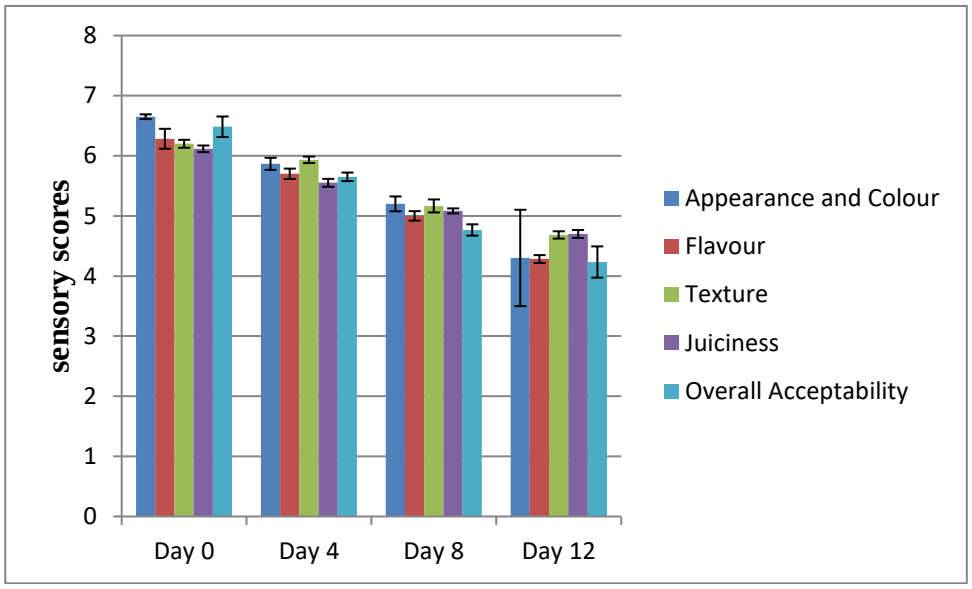


Figure 3: Sensory attributes of Bhutwa during refrigerated storage

Addition of T and C had significant effect on overall acceptability scores of Bhutwa. Mean value for Con was found to be significantly lower as compared to that of T, C and TC (Fig. 3). TC had significantly higher scores, when compare to T and C. It might be due to less discoloration and lipid oxidation. However no significant (P>.0.05) difference was found between T and C. Enhanced overall acceptability of chicken meat spread supplemented with tomato powder was also observed by Anita *et al*. (2016). Martinez *et al.* (2006) observed off odor score increased significantly (P<0.05) throughout storage, but at a different rate. Off-odor formation was very significantly delayed in sausages with added capsicum (Savaadkohi *et al.,* 2014). A significant progression in the textural characteristics and overall sensory scores of beef frankfurter, beef ham and meat-free sausage produced containing tomato pomace was reported by Savadkoohi *et al.* (2014).

Conclusion

Goat byproducts- intestine, rumen, reticulum, liver, lung and trachea were utilized in the product with the concept of low-cost nutritious product moreover with good sensory acceptability. Added tomato powder and green chili

powder improved the antioxidant, microbiological as well as sensory quality of the product. Control group showed signs of spoilage from the beginning of 8th day whereas product added with these ingredients showed signs of spoilage on 12th day. Findings of present work unveil significant utilization of edible goat byproduct into a value-added product as well as effective use of added natural antioxidants to enhance product quality.

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Conflict of Interests

There is no conflict of interest.

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References

1. Addrizzo, J. R. (2004). Use of goat milk and goat meat as therapeutic aids in cardiovascular diseases. *Dairy Goat Journal*, *82*(4), 27-27.
2. Anandh, M. A., Jagatheesan, P. R., Rajarajan, G., Kumar, P. S., Paramasivam, A., & Lakshmanan, V. (2012). Quality and acceptability of traditional styled fried Tripe products from buffalo and goat rumen meat. *International Food Research Journal*, *19*(3), 807.
3. Anita, Mendiratta, S. K., Agarwal, R. K., Bharti, S. K., & Singh, T. P. (2015). Quality evaluation of hurdle treated chicken sandwich spread applying different processing variables. *Indian Journal of Poultry Science*, 50(2), 197-202.
4. Arya, A., Mendiratta, S. K., Agarwal, R. K., Bharti, S. K., & Umarao, P. (2019). Antimicrobial profile and organoleptic acceptability of some essentials oils and their blends in hurdle treated chicken meat spread. *International Journal of Current Microbiology and Applied Sciences*, 8(9), 2162-2177.
5. Arya, A., Mendiratta, S. K., Singh, T. P., Agarwal, R., & Bharti, S. K. (2017). Development of sweet and sour chicken meat spread based on sensory attributes: process optimization using response surface methodology. *Journal of food science and technology*, 54(13), 4220-4228.
6. Bharti, S. K., Pathak, V., Goswami, M., Sharma, S., Ojha, S. and Anita (2017). Quality assessment of *Nelumbo nucifera* supplemented functional muscle food. *Journal of Entomology and Zoology Studies*, *5*(4), 445-451.
7. Breidenstein, B. C., & Williams, J. C. (1987). Contribution of red meat to the US diet.
8. Calvo, M. M., Garcia, M. L., & Selgas, M. D. (2008). Dry fermented sausages enriched with lycopene from tomato peel. *Meat Science*, *80*(2), 167-172.
9. Candogan, K. (2002). The effect of tomato paste on some quality characteristics of beef patties during refrigerated storage. *European Food Research and Technology*, *215*(4), 305-309.
10. Devendra, C., & Owen, J. E. (1983). Quantitative and qualitative aspects of meat production from goats. *World Animal Review*.
11. Doménech-Asensi, G., García-Alonso, F. J., Martínez, E., Santaella, M., Martín-Pozuelo, G., Bravo, S., & Periago, M. J. (2013). Effect of the addition of tomato paste on the nutritional and sensory properties of mortadella. *Meat Science*, *93*(2), 213-219.
12. Gök, İ., Askın, O. O., Özer, C. O., & Kılıç, B. (2012). Effect of textured soy protein and tomato pulp on chemical, physical and sensory properties of ground chicken döner kebab. *African Journal of Biotechnology*, *11*(25), 6730-6738.
13. Gupta, R., Thind, S. S., Kaur, A., & Bhise, S. (2017). Development of Chicken Meat Cutlets Incorporating Carrots and Oats as Functional Ingredients. *International Journal of Food and Fermentation Technology*, *7*(1), 41-53.
14. Holden, J. M., Lemar, L. E., & Exler, J. (2008). Vitamin D in foods: development of the US Department of Agriculture database. *The American Journal of Clinical Nutrition*, *87*(4), 1092S-1096S.
15. Kim, H. S., & Chin, K. B. (2016). Effects of drying temperature on antioxidant activities of tomato powder

and storage stability of pork patties. *Korean Journal for Food Science of Animal Resources*, *36*(1), 51.
16. Kim, I. S., Jin, S. K., Yang, M. R., Chu, G. M., Park, J. H., Rashid, R. H. I. & Kang, S. N. (2013). Efficacy of tomato powder as antioxidant in cooked pork patties. *Asian-Australasian Journal of Animal Sciences*, *26*(9), 1339.
17. MacHugh, D. E., & Bradley, D. G. (2001). Livestock genetic origins: goats buck the trend. *Proceedings of the National Academy of Sciences*, *98*(10), 5382-5384.
18. Madruga, M. S., Dos Santos, M. N., Costa, R. G., De Medeiros, A. N., do Egypto, R. Q., Schuller, A. R. & Campos, R. A. (2007). Fat components from precooked "buchada": an edible goat meat by-product componentes de la grasa de "buchada" precocida: un subproducto comestible de la carne de cabra. *CYTA-Journal of Food*, *5*(4), 265-270.
19. Martínez-Valverde, I., Periago, M. J., Provan, G., & Chesson, A. (2002). Phenolic compounds, lycopene and antioxidant activity in commercial varieties of tomato (*Lycopersicum esculentum*). *Journal of the Science of Food and Agriculture*,*82*(3), 323-330.
20. McMillin, K. W., & Brock, A. P. (2005). Production practices and processing for value-added goat meat. *Journal of Animal Science*, *83*(suppl_13), E57-E68.
21. Modzelewska-Kapituła, M. (2012). Effects of tomato powder on color, lipid oxidation and sensory properties of comminuted meat products. *Journal of Food Quality*, *35*(5), 323-330.
22. Morand-Fehr, P., Boutonnet, J. P., Devendra, C., Dubeuf, J. P., Haenlein, G. F. W., Holst, P. & Capote, J. (2004). Strategy for goat farming in the 21st century. *Small Ruminant Research*, *51*(2), 175-183.
23. Najeeb, A. P., Mandal, P. K., & Pal, U. K. (2015). Efficacy of Gooseberry, Tomato and Red Grapes Powder as Preservative in Restructured Chicken Block. *Meat Sci*, *10*, 21-25.
24. Olorunsanya, A. O., Olorunsanya, E. O., Aliu, O. T., & Kayode, R. M. O. (2009). Effects of different species of pepper (Capsicum) on oxidative stability of raw and cooked pork patties. *Pakistan Journal of Nutrition*, *8*(10), 1588-1591.
25. Østerlie, M., & Lerfall, J. (2005). Lycopene from tomato products added minced meat: Effect on storage quality and colour. *Food Research International*, *38*(8-9), 925-929.
26. Perry, D., Nicholls, P. J., & Thompson, J. M. (1998). The effect of sire breed on the melting point and fatty acid composition of subcutaneous fat in steers. *Journal of Animal Science*, *76*(1), 87-95.
27. Porter, V. (1996). *Goats of the World*. Farming Press.
28. Pringle, H. (1998). Reading the signs of ancient animal domestication (vol 282, pg 1448, 1998). *Science*, *282*(5395), 1827-1827.
29. Ruanma, K., Shank, L., & Chairote, G. (2010). Phenolic content and antioxidant properties of green chilli paste and its ingredients. *Maejo International Journal of Science and Technology*, *4*(2), 193-200.
30. Salem, R. H. (2013). Quality characteristics of beef sausages with tomato peel as a colour and functional additive during frozen storage. *World Applied Sciences Journal*, *22*(8), 1085-1093.
31. Savadkoohi, S., Hoogenkamp, H., Shamsi, K., & Farahnaky, A. (2014). Color, sensory and textural attributes of beef frankfurter, beef ham and meat-free sausage containing tomato pomace. *Meat Science*, *97*(4), 410-418.
32. Tarladgis, B. G., Watts, B. M., Younathan, M. T., & Dugan Jr, L. (1960). A distillation method for the quantitative determination of malonaldehyde in rancid foods. *Journal of the American Oil Chemists' Society*, *37*(1), 44-48.

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