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Standardization, Characterization and Storage Stability of Chevon Pithe: A Traditional Indian Meat Cake

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ABSTRACT

The present study was envisaged to standardize a traditional meat product of Purulia District, West Bengal, India, chevon pithe (meat cake), characterize its quality and to study shelf-life in refrigerated storage (4±1°C). The formulation and procedure was standardized through several preliminary trials. The traditionally made (TCP) and laboratory made 'Chevon-Pithe' (LCP) were compared for different physicochemical, sensory and microbial quality. The cooking yield (%), moisture retention (%), fat retention (%) and water holding capacity (%) of cooked LCP samples were found to be 76.62±1.43, 48.85±1.19, 88.14±2.12 and 42.55±1.17, respectively. Moisture (%), protein (%), ether extract (%) and total ash (%) of LCP samples were found as 64.31±0.83, 10.59±0.34, 13.71±1.28, 11.52±0.86 and 2.86±0.71, respectively and the cholesterol (mg %) content of LCP sample was 62.22±1.78. TBA value (mg malonaldehyde kg^{-1}) of cooked LCP samples was 0.368±0.024 at 0 day and 1.037±0.063 at 14th day. Peroxide value (meq kg^{-1}) and free fatty acid (% oleic acid) of cooked LCP samples were found to be 1.160±0.129 and 0.217±0.092 at 0 day and 6.290±0.163 and 3.998±0.178 at 14th day, respectively. The study revealed that the LCP retained its acceptability up to 14th day of refrigerated storage (4±1°C). Traditionally made one also got sufficient consumer attention not very differently, throughout the storage. Based on the results it was concluded that 'chevon-pithe' can be commercially prepared and marketed as a value added meat product.

Key words: Chevon-pithe, meat-cake, storage stability, sensory properties, texture profile analysis

INTRODUCTION

Raw meat gets spoiled at high ambient temperature due to its high moisture and protein contents. Several technologies are in practice to prolong the shelf life of perishable raw meat such as drying, smoking, fermenting, curing (Dzudie *et al*., 1996; Rantsiou and Cocolin, 2006). Although processing minimizes the risk of spoilage and prolong the shelf life, yet processed products are not 100% safe for consumption after a long storage, unless it is kept in refrigeration or frozen temperature.

Many traditional meat products of different countries have been well documented and studied such as alheira of Portugal (Ferreira *et al*., 2006) androlla of Spain (Fontan *et al*., 2007), nham of

Thialand (Visessanguan *et al*., 2006), salsiccia and soppressata of Italy, jerky of USA (Rai *et al*., 2009). The rich heritage of India contributes to wide range of traditional foods. Indigenous meat products are unique in their spicy flavor and ease of preparation. They have the potential of becoming value added convenience food product of good palatability (Bhat *et al*., 2011).

India has 126 million goats among which 47.8 millions are slaughtered per year for meat purpose (FAO, 2009). Chevon meat is a part of diet for many ethnic people in Purulia district of West Bengal, India. Chevon pithe is an indigenous meat based product of this region which is very much relished by local people. People of this region use their traditional knowledge and techniques to prepare various types of meat cake especially during festivals and holy celebration. The sensory acceptability and nutritional strength of the product may not be lower than that of any comminuted or value added meat product. The formulation of the product is not yet documented, standardized or disseminated outside the district as the preparation is purely traditional.

'Chevon pithe' is a flat cake like preparation of minced goat meat and fat with rice flour and condiments and spices by roasting in pan, prepared in Purulia district of West Bengal, India. Traditionally made 'Pithe' cannot be preserved safely for more than 2 or 3 days because of high ambient temperature (40-50°C) of the place almost throughout the year, lack of refrigerator in maximum household for storage and improper method of handling, storage and packaging. As such there seems to be no standard method of preparation of pithe and control of its quality. Furthermore, no information is available in the literature on the processing and quality of chevon pithe. Thus, there is an immediate need of scientific standardization and evaluation of the product so that literature will be generated and further research could be conducted on the product.

Therefore, this study was planned to characterize the 'chevon pithe' a traditional meat product under laboratory condition and compare it with the traditionally made one. Particular reference is made to factors like physicochemical, microbiological, textural and sensory attributes which might influence the safe consumption and draw sufficient consumers' attraction of this product.

MATERIALS AND METHODS

The study was conducted in Department of Livestock Products Technology, West Bengal University of Animal and Fishery Sciences, Kolkata, India during September, 2011 to August, 2013. All the chemicals and media used in the study were of analytical grade and were obtained from standard firms (Hi media, Merck; India).

Traditionally made chevon pithe samples for this study were procured time to time from randomly selected households of Purulia district, West Bengal, India, for physicochemical, textural, sensory analysis and storage study evaluation. The base formulation of the product and method of preparation were taken from the local culinary concept and standardized (Table 1) through several preliminary trials and modified accordingly on the basis of sensory parameters of 'served-warm' pithe. The sensory panel for the preliminary trials comprised of scientific staffs and post graduate students. The laboratory made chevon pithe is abbreviated as 'LCP' and traditionally made one termed as 'TCP' throughout this paper.

Preparation of chevon pithe: For preparing chevon pithe, about 1 kg of dressed and deboned chevon was taken from local market. Spice mix, condiment mix, mustard oil, table salt, packaging materials and other necessary ingredients were procured from local market. The deboned meat was

Table 1: Formulation (recipe) of chevon pithe

Ingredients (%)	TCP	LCP
Lean goat meat	50	50
Rice flour	35	35
Animal fat	5	5
Refined oil	5	5
Spice mix	2	2
Condiment mix*	5	5
Salt	2.5	2.5
Sodium nitrite (ppm)	-	150
Sodium tripolyphosphate	-	0.2

*Onion: ginger: garlic: green chilli = 3:1:2:1, TCP: Traditional chevan pithe, LCP: Laboratory made chevon pithe

chopped coarsely with the help of a sharp knife to make into small pieces. The required amount of chevon fat, salt, spices and oils (Table 1) are mixed well with the meat to prepare 'Part A'. Required quantity of hot water (82°C) was mixed with this part to ensure melting of the animal fat and its uniform distribution. Special care was taken during mixing and blending to ensure proper entry of salt and spices into the meat. Another part (Part B) was consisting of rice flour paste. To prepare rice paste, approximately 1 kg of rice was soaked in hot water (80°C) for approximately 4 h. Then the soaked rice was partially dried by passing it through a strainer and grinded (Phillips mixer and grinder) until a fine powder was obtained. The powder was taken in a plate and required amount of hot water (82°C) was added to it. Rice flour paste (Part B) was prepared by mixing and kneading it properly with hot water. Then Part A was blended and kneaded with Part B to obtain the final batter. Condiment mix as per the formulation (Table 1) was mixed with this batter.

The cooking was done on a preheated frying pan (Indian Tawa) by shallow frying method. The frying pan, sprinkled with a little amount of vegetable oil was pre-heated to 85°C on an Indian clay oven and the batter preparation was poured gently over the pan to give a round shaped cake. Required quantity of oil was poured time to time at the edge of the cake to avoid burning at the surface. After 10 min, the cake was turned upside down for uniform cooking at both surface. The total cooking time recorded was 15 min.

Cooking determinants like cooking yield, moisture retention and fat retention of the cooked samples were calculated on LCP samples only. On day 0, the LCP samples were analyzed for water holding capacity, proximate composition and cholesterol content. Storage studies of both LCP and TCP samples were conducted in refrigerator and samples were drawn on 0, 3, 7, 10 and 14th day (to analyze pH, thio-barbituric acid value, peroxide value, free fatty acid value, tyrosine value, microbiological quality (SPC, PPC), sensory attributes, color measurement and Texture Profile Analysis (TPA).

Cooking yield: To determine the cooking yield, the LCP samples were weighed before and after cooking and expressed in percent.

Percent moisture and fat retention: The moisture and fat retention of LCP samples were calculated as per the method outlined by El-Magoli (1996) and expressed in percent.

Water holding capacity: Water Holding Capacity (WHC) was determined by modifying the method of Hughes *et al.* (1997) as outlined by Cengiz and Gokoglu (2007).

Proximate analysis: Moisture, protein, fat and total ash content of LCP sample was determined as per AOAC (1984) method.

Cholesterol content: Total cholesterol content in cooked chevon pithe (LCP samples) was determined by using the method of Zlatkis *et al.* (1953) with little modifications as described by Rajkumar *et al.* (2004).

Estimation of pH: The pH of the cooked LCP samples were estimated by the method described by Egbert *et al.* (1992).

Thiobarbituric acid: The TBA value was estimated as per procedure given by Tarladgis *et al.* (1960).

Peroxide value: Peroxide value was estimated as per procedure given by AOCS (1992) with slight modifications. Five g of sample was weighed and mixed with 30 mL acetic acid-chloroform solution (3:2) in 250 mL glass-stoppered Erlenmeyer flask. Slurry obtained was gently swirled to extract lipid and then 0.5 mL saturated potassium iodide solution was added. After reaction for 1 min with occasional shaking, 30 mL of distilled water and 0.5 mL of 0.5% starch solution were added. The mixed solution was titrated with 0.01 N sodium thiosulphate until intense blue colour disappeared. A blank was also determined and subtracted from sample titration. PV was calculated from the following formula:

$$\text{PV (meq kg}^{-1}) = \frac{\text{mL of Na-thiosulphate} \times \text{N of Na-thiosulphate}}{\text{Weight of sample}} \times 1000$$

Free fatty acid: Free fatty acid value was determined by modified AOCS method (Koniecko, 1979).

Tyrosine Value (TV): For assessing of tyrosine value, the procedure of Strange *et al.* (1977) was followed with some modification. Twenty gram of product was blended with 50 mL of pre-cooled 20% TCA (Trichloro acetic acid) solution for 2 min. The blended contents were transferred to a beaker after rinsing with 50 mL of cold water and mixed together. The mixture was filtered through Whatman filter paper No. 42 to get TCA extract. Trichloro acetic acid (TCA) extract of 2.5 mL was diluted with equal amount of distilled water, then 10 mL of 0.5 N freshly prepared sodium hydroxide and 3 mL of diluted phenol Folin-ciocalteu's reagent (1:2 with distilled water) were added. After 30 min OD was measured at 730 nm in a spectro-photometer. Tyrosine value was calculated by referring to the standard curve prepared following the procedure of Pearson (1968) and expressed as milligram of tyrosine per gram of test sample.

Standard Plate Count (SPC): SPC was determined by the APHA (1992) method using plate count agar. One millilitter of appropriate dilution of sample was transferred aseptically to sterile petri-plates in triplicate. The plates were then poured with 10-15 mL melted agar medium at 45°C. After solidification the petri-plates were incubated at 37°C for 24-48 h. The colonies were counted by using colony counter. The average number of colonies was multiplied with dilution factor to obtain total count as Colony Forming Unit (CFU) per gram of the sample. This count was then converted to log CFU g^{-1} of sample.

Psychrophilic count (PPC): The plates were prepared similar to that of SPC but incubated for 10 days. The colonies were counted and expressed as log CFU g^{-1}.

Texture Profile Analysis (TPA): Texture profile analysis of 'chevon pithe' was conducted on 0, 3, 7, 10 and 14th day using the procedure described by Bourne (1978). The textural characteristics of pithe were determined using Texture Analyzer (TA-HDi, Stable Micro Systems, UK). Samples of cooked pithe were thawed overnight and allowed to attain room temperature (25°C). Central cores of five pieces of each sample (1.5×1.5×1.5 cm) from the middle portion of each pithe were used as the test samples which were placed on platform fixture and compressed twice to 80% of the original height at a crosshead speed of 2 mm sec^{-1} through two cycle sequence at pre test speed of 2 mm sec^{-1}, post test speed of 2 mm sec^{-1}, distance 8.5 mm and a trigger of 0.15 N using 50 kg load cell and 75 mm compression platen probe (P75). The following TPA parameters were computed below:

- **Hardness (N cm^{-2}):** Resistance at maximum compression of first bite to deform the sample
- **Springiness or elasticity (cm):** The distance that the sample recovered its height between the first and second compressions
- **Cohesiveness:** Positive force ratio of the second compression area to the first compression area (A_2/A_1)
- **Gumminess (N cm^{-2}):** Force necessary to disintegrate a semi-solid sample for swallowing, it is the multiplication of hardness and cohesiveness
- **Chewiness (N cm^{-1}):** Work to masticate the sample for swallowing. It is the multiplication of gumminess and elasticity

All the TPA parameters were replicated for six times per treatment group.

Colour measurements: The colour of cooked pithe (both TCP and LCP samples) was compared using a Lovibond Tintometer (Tintometer Ltd, Salisbury, UK). Samples from three different places of chevon pithe were taken in the sample holder and secured against the viewing aperture. The sample colour was matched by adjusting red (a) and yellow (b) units, while keeping the blue units fixed at 2.0. The corresponding colour units were recorded. The hue and chroma (saturation) values were determined using the formula, $\tan^{-1}$ b/a and (a2+b2) 1/2 (Froehlich *et al*., 1983), respectively, where, a is the red unit, b the yellow unit.

Sensory evaluation: The sensory evaluation of chevon pithe samples were done on 0, 3, 7, 10 and 14th day. Sensory evaluation was conducted as per Keeton (1983), using an eight-point descriptive scale, where 8 = Excellent, 1 = Extremely poor. The sensory panel consisted of scientific staff and post-graduate students of the department. The panelists were explained about the nature of the experiments without disclosing the identity of samples and were asked to rate their preferences on the sensory evaluation proforma for different traits. Samples were warmed using microwave oven for 1 min, cut across the centre to make equal size and shape and served to panelists. Water was provided to rinse mouth between the samples. The panelists judged the samples for their general appearance, flavor, juiciness, texture and overall acceptability.

Statistical analysis: The experiment was repeated three times and all chemical and physical determinations were done in duplicate and the data were subjected to one-way or two-way analysis of variance as per the case. To test the significance among the means in each group, *post hoc* test (Tukey's HSD) has been carried out using SPSS- 16® software package at 5% level of significance.

RESULTS AND DISCUSSION

Cooking determinants: Cooking determinants were determined at 0 day on cooked LCP samples only and the mean values and standard errors are presented in Table 2. The cooking yield (%), moisture retention (%) and fat retention (%) of cooked LCP samples were found to be 76.62±1.43, 48.85±1.19 and 88.14±2.12, respectively.

The cooking yield of LCP samples found to be sufficiently high when compared to other comminuted and convenient meat products. Process economics are better if product cook yield is high. Also, meat products with a high cook yield tend to be more juicy and tender than products with a low cook yield (Swan *et al.*, 1998). El-Magoli *et al.* (1996) noted 59.3 and 70.4% cooking yield of high-fat and low-fat ground beef patties, respectively. In the same study, they found that moisture retention of high-fat and low-fat ground beef patties were 30.3 and 41.5%, whereas, fat retention were 41.6 and 58.4%, respectively. The results of this study corroborate with the findings of James and Berry (1997), who investigated cooking yield of low-fat chevon patties by different cooking methods. However, the cooking yield (%) of chevon pithe was far lower than the data obtained by Das *et al.* (2008a). They obtained a cooking yield of 97.69% while studying on goat meat nuggets. This might be due to the fact that goat meat (%) in the formulation of chevon pithe was much lesser than that of the chevon nuggets. Hence, weight loss of non-meat ingredients and water on cooking may be the cause of lower product yield. Rather, findings of this study can be compared with that of the findings of Lee *et al.* (1999), who reported 63.4% product yield of ground beef pattie model system.

Water holding capacity: Water holding capacity is the ability of meat or more generally meat systems to hold all or part of its own and or added water (Honikel and Hamm, 1995). WHC of meat product is reflected in the juiciness of the product which is one of the important sensory attribute.

The mean WHC value and standard error of cooked LCP sample was 42.55±1.17 (Table 2). This value cannot be solely attributed to WHC of meat and meat products only as the non-meat ingredients such as rice flour plays a vital role in WHC of the final product, especially when their proportion in the formulation is sufficiently high. Das *et al.* (2006) reported a WHC of 12.56% at 0 day of storage of ground buffalo meat. Das *et al.* (2011) obtained a WHC of 15.43% at 1st day

Table 2: Physico-chemical quality of fresh chevon pithe (Mean±SE)

Parameters	LCP (%)	TCP (%)
Cooking yield	76.62±1.43	72.22±2.11
Moisture retention	48.85±1.19	41.06±1.51
Fat retention	88.14±2.12	85.53±1.65
Water holding capacity	42.55±1.17	37.28±1.42
Moisture	64.31±0.83	60.04±1.28
Protein	10.59±0.34	8.46±0.59
Ether extract	13.71±1.28	14.98±1.75
Total ash	2.86±0.71	4.11±0.29
Cholesterol (mg)	62.22±1.78	67.47±1.29

of storage of goat meat patties. The elevated WHC (%) value of LCP samples obtained in this study may be due to the significant amount of rice flour in the formulation which contributed the increased water holding capacity in the meat emulsion.

Proximate composition and cholesterol content: The mean proximate values and cholesterol content of cooked LCP sample and their standard errors are presented in Table 2. The results are similar to that with goat meat nuggets (control) reported by Das *et al.* (2008a), except a much lower protein content which may be again explained by the high contribution of non-meat ingredients in the formulation. Cholesterol content of goat meat is 63.8 (mg %) (Anaeto *et al.*, 2010). The LCP samples showed a value of 62.22 (mg %) cholesterol content which is closely in resemblance with all goat meat products. Perhaps the amount of cholesterol apart from that contributed by meat comes from oil or fat used in the formulation and fat trapped in the product during cooking.

Storage studies

pH value: The mean pH values and standard deviations of cooked LCP and TCP samples at refrigerated storage (4±1°C) of 0, 3rd, 7th, 10th and 14th day are presented in Table 3. Initially, pH of LCP samples declined significantly ($p<0.05$) up to 3rd day of storage and then increased significantly ($p<0.05$). However, after 10th day of refrigerated storage, the increment became insignificant ($p>0.05$). Such decline in pH might be due to the action of psychrophilic bacteria which ferment the carbohydrate present in the ingredients used in the formulation of the product and the subsequent increment of pH was due to the liberation of metabolites from the bacterial activity as the microbial load enhanced with storage period. However, such trend was not noticed in case of TCP samples, which exhibited a significant ($p<0.05$) increment in pH values up to 10th day. This may be due to excess of initial microbial activity over the action of psychrophilic bacterial carbohydrate fermentation. Reddy and Rao (1996), Papadima and Bloukas (1999), Singh and Verma (2000) and Nayak and Tanwar (2004) also reported similar increasing trend of pH during refrigerated storage of different meat products.

TBA value: The mean TBA values and standard deviations of LCP and TCP samples at different storage period are presented in Table 3. No significant effect in TBA values of both LCP and TCP

Table 3: Chemical quality of chevon-pithe during refrigerated storage (Mean±SD)

Days	pH	TBA value (mg malonaldehyde kg^{-1})	Peroxide value (meq kg^{-1})	Free fatty acid (% oleic acid)	Tyrosine value (mg g^{-1})
LCP					
0	5.810±0.109^{a}	0.368±0.024^{a}	1.160±0.129^{a}	0.217±0.092^{a}	0.175±0.022^{a}
3	5.735±0.060^{b}	0.408±0.033^{a}	2.318±0.142^{b}	1.393±0.093^{b}	0.248±0.022^{b}
7	6.092±0.048^{c}	0.500±0.023^{b}	4.197±0.116^{c}	2.258±0.193^{c}	0.305±0.015^{c}
10	6.337±0.070^{d}	0.853±0.063^{c}	5.197±0.096^{d}	3.142±0.209^{d}	0.332±0.016^{d}
14	6.413±0.079^{d}	1.037±0.063^{d}	6.290±0.163^{e}	3.998±0.178^{e}	0.380±0.014^{e}
TCP					
0	6.142±0.023^{a}	0.400±0.290^{a}	1.385±0.113^{a}	0.232±0.064^{a}	0.123±0.029^{a}
3	6.612±0.142^{b}	0.428±0.015^{a}	2.453±0.108^{b}	1.670±0.108^{b}	0.217±0.014^{b}
7	6.778±0.055^{c}	0.532±0.033^{b}	4.370±0.124^{c}	2.552±0.145^{c}	0.272±0.014^{c}
10	6.968±0.054^{d}	0.983±0.077^{c}	5.423±0.131^{d}	3.317±0.189^{d}	0.342±0.015^{d}
14	6.985±0.092^{d}	1.262±0.069^{d}	6.773±0.158^{e}	4.328±0.189^{e}	0.412±0.017^{e}

Means bearing different superscript letters within a treatment group (column) differ significantly ($p<0.05$)

samples was observed up to 3rd day of storage. After that, a gradual and significant ($p<0.05$) increasing trend was noticed in both the samples. However, a numerically larger value was found in TCP samples when compared with LCP sample of the corresponding storage day. This might be due to hygienic processing and handling which might be the cause of low initial microbial load and thereby less lipid oxidation. Bhat *et al.* (2011) also found similar increasing trend in TBA values of chevon harrisa in refrigerated storage. This is also in agreement with the findings of Reddy and Rao (1997), Thompson *et al.* (1983) and Nag *et al.* (1998).

Peroxide value: The peroxide value is a useful method to determine the early stages of fat oxidation and the product is considered rancid when PV of 20-40 meq kg^{-1} is reached (Economou *et al.*, 1991). The mean peroxide values and standard deviations of LCP and TCP samples at different storage periods are presented in Table 3. Both the LCP and TCP samples showed a gradual significant ($p<0.05$) change in peroxide value with advancement of storage period. Numerically, all the values were far below of 20 meq kg^{-1}. The data was supported by the findings of Hassan and Fan (2005) and Soyer *et al.* (2010) who reported significant effect ($p<0.01$) of storage period on the PV of meat samples.

Free fatty acid value: Free fatty acids are the products of enzymatic or microbial degradation of lipids. Determination of FFA gives information about stability of fat during storage (Das *et al.*, 2008a). The mean values of the free fatty acids (% oleic acid) of LCP and TCP samples increased significantly ($p<0.05$) with the advancement of storage period Table 3. This is supported by the findings of Bhat *et al.* (2011), Anand *et al.* (1991), Nayak and Tanwar (2004) and Nagamallika *et al.* (2006) in various meat products during refrigerated storage.

Tyrosine value: The degree of autolysis and bacterial proteolysis in meat could be measured as tyrosine value which actually determined the quantity of amino acid-tyrosine and tryptophan present in an extract of meat. Significant effect ($p<0.05$) in tyrosine values was noticed throughout the storage period Table 3. An interesting point while comparing the tyrosine values between LCP and TCP samples is that initially LCP samples showed higher values than TCP but on about 10th day onwards TV values of TCP samples rose against LCP. This might be explained by the vigorous chopping of the chevon meat by sharp knife in laboratory made 'pithe' whereas TCP samples contain much larger meat pieces. It might be assumed that during chopping, the number of protein chain breakdown and amino acids released into the meat system contributed to this difference in initial tyrosine values between LCP and TCP samples. After that, with the advancement of storage period, tyrosine value increased significantly ($p<0.05$) in both the samples. Such increment might be due to the enhanced microbial load, enhanced production of proteolytic enzymes in the late logarithmic phase of microbial growth which were altogether responsible for autolysis and bacterial proteolysis (Dainty *et al.*, 1975). As the TCP samples were prepared under relatively less hygienic condition, the bacterial growth, autolysis and proteolysis could not be controlled after 10 days and hence it rose over the LCP samples. The results of the present study could also be collated with the observation of Pearson (1968) and Dainty *et al.* (1975) where they also reported the similar effect of storage period on tyrosine value of different types of meat products.

Microbial count: All microbial counts of chevon pithe samples determined during refrigerated storage were low in number and can be categorized as satisfactory and within the acceptable range

for cooked meat products (Table 4). On 0 day, a higher value of SPC and PPC was noted for TCP samples (2.80±0.130 and 1.32±0.077 log CFU g^{-1}, respectively) than LCP sample (2.43±0.084 and 1.20±0.100 log CFU g^{-1}, respectively). This difference in microbial load of two chevon pithe samples certainly indicates better hygienic practices in laboratory processing. Up to 3rd day, there was no significant change in SPC and PPC values in both samples. After that, significant increment ($p<0.05$) was noticed in SPC and PPC values for both the samples at each storage days.

Microbiological studies indicated that all the parameters showed a significant ($p<0.05$) increasing trend throughout the storage period. Das *et al.* (2008b) observed similar increasing trend of SPC and PPC while studying on chevon nuggets in frozen storage. Nag *et al.* (1998) also observed a similar incresing trend in total plate count under refrigerated storage while studying on quality attributes and shelf life of chicken nuggets extended with rice flour. However, both the SPC and PPC values of chevon pithe had not exceeded the permissible limit, i.e., log 106 CFU g^{-1} of sample for SPC (Jay, 1996) in cooked meat product and 4.6 log CFU g^{-1} for PPC values as reported by Ciemer and Chipley (1977), suggesting that the chevon pithes were microbiologically safe for consumption up to 14th day of refrigerated storage.

Texture Profile Analysis (TPA): Hardness values of both LCP and TCP samples remain lower up to 7th day of refrigerated storage, after that a sudden increasing trend was noticed in both samples (Table 5), which found to be statistically significant ($p<0.05$). No significant effect ($p>0.05$) was noticed in springiness values up to 3rd day of refrigerated storage after which it declined significantly ($p<0.05$) throughout the storage period (Table 5). Cohessiveness, gumminess and chewiness values declined significantly ($p<0.05$) throughout the storage days (Table 5). Visessanguan *et al.* (2006) also observed a significant ($p<0.05$) increasing trend up to 84th h in all the TPA parameters of 'Nahm'-a fermented pork sausage in Thailand, inoculated with different inoculum levels of *Lactobacillus curvatus*. Andres *et al.* (2009) also got similar results in hardness of chicken sausages formulated with different lipid sources and they described this increment of hardness values with storage time as a result of purge losses which makes the water less available as plasticizer of the matrix. The results of this study corroborate with the findings of Walczycka and Migdal (2007), who observed that hardness of model sausages with different level of dried powders

Table 4: Microbiological quality of chevon-pithe during refrigerated storage (Mean±SD)

Days	SPC value (log CFU g^{-1})	PPC value (log CFU g^{-1})
LCP		
0	2.425±0.084^{a}	1.195±0.100^{a}
3	2.576±0.072^{a}	1.340±0.126^{a}
7	2.843±0.099^{b}	1.538±0.066^{ab}
10	3.347±0.096^{c}	1.713±0.564^{b}
14	3.972±0.112^{d}	2.252±0.335^{c}
TCP		
0	2.790±0.130^{a}	1.319±0.077^{a}
3	2.797±0.121^{a}	1.432±0.049^{ab}
7	3.122±0.085^{b}	1.738±0.055^{b}
10	3.453±0.053^{c}	1.862±0.089^{b}
14	4.371±0.155^{d}	2.302±0.069^{c}

Means bearing different superscript letters within a treatment group (column) differ significantly ($p<0.05$)

of fruit and vegetables grew significantly with the advancement of storage days under refrigeration temperature. However, the values obtained for all the TPA parameters of both LCP and TCP samples throughout the storage days were comparable with goat meat nuggets incorporated with full fat soy paste and textured soy granules (Das *et al.*, 2008a), goat meat patties (Das *et al.*, 2008b), buffalo meat nuggets (Thomas *et al.*, 2007) and pork-sausages stored at ambient temperature (Thomas *et al.*, 2008).

Instrumental colour: The redness values (a) of both cooked LCP and TCP samples declined after 7th day (Table 6), whereas yellowness (b) values of TCP samples grew significantly ($p<0.05$) after 7th day. These findings are partially in contrast with the previous investigation of Andres *et al.* (2009), who observed an increasing trend ($p<0.01$) up to 20th days both in redness (a) and yellowness (b) values of chicken sausages formulated with different lipid sources. Hue values of both the samples increased significantly ($p<0.05$) after 3rd day of storage. After 3rd day of storage, a significant ($p<0.05$) decreasing trend was noticed for Chroma (saturation index) values of both the samples throughout the storage period Table 6. However, no significant effect ($p>0.05$) was noticed in yellowness (b) values of LCP samples irrespective of storage time.

Table 5: Texture profile analysis of chevon-pithe during refrigerated storage (Mean±SD)

Days	Hardness (N cm^{-2})	Springiness (cm)	Cohessiveness	Gumminess (N cm^{-2})	Chewiness (N cm^{-1})
LCP					
0	50.76±1.212^{a}	0.732±0.0116^{a}	0.245±0.0067^{a}	15.28±0.561^{a}	10.52±0.755^{a}
3	51.05±0.802^{a}	0.724±0.0107^{a}	0.238±0.0049^{ab}	14.89±0.536^{b}	10.13±0.561^{ab}
7	52.92±2.720^{a}	0.693±0.0171^{b}	0.227±0.0063^{bc}	14.51±0.560^{bc}	10.05±0.286^{ab}
10	56.87±1.768^{b}	0.672±0.0133^{b}	0.222±0.0102^{cd}	13.49±0.684^{cd}	9.89±0.261^{b}
14	60.29±1.687^{c}	0.648±0.0154^{c}	0.210±0.0064^{d}	13.28±0.894^{d}	9.72±0.372^{b}
TCP					
0	52.69±1.592^{a}	0.753±0.0179^{a}	0.239±0.0035^{a}	15.21±0.546^{a}	10.09±0.611^{a}
3	52.90±1.578^{a}	0.738±0.0122^{a}	0.231±0.0135^{ab}	13.86±0.534^{b}	9.62±0.399^{ab}
7	53.12±1.577^{a}	0.687±0.0142^{b}	0.223±0.0067^{bc}	13.37±0.703^{bc}	9.58±0.405^{ab}
10	59.26±2.508^{b}	0.665±0.0130^{bc}	0.215±0.0126^{cd}	12.94±0.874^{cd}	9.47±0.478^{b}
14	62.71±2.814^{b}	0.642±0.0121^{c}	0.209±0.0077^{d}	12.52±0.767^{d}	9.31±0.225^{b}

Means bearing different superscript letters within a treatment group (column) differ significantly ($p<0.05$)

Table 6: Instrumental colour of chevon-pithe during refrigerated storage (Mean±SD)

Days	Redness (a)	Yellowness (b)	Hue	Chroma
LCP				
0	6.92±0.244^{a}	14.06±1.011	58.27±1.463^{a}	15.31±0.319^{a}
3	6.79±0.318^{ab}	14.12±0.109	59.31±0.533^{ab}	15.11±0.258^{ab}
7	6.73 ±0.132^{abc}	14.17±0.071	63.45±0.503^{b}	14.87±0.209^{b}
10	6.57±0.118^{bc}	14.26±0.209	64.84±0.517^{c}	14.05±0.141^{c}
14	6.42 ±0.159^{c}	14.28±0.138	65.22±0.739^{c}	13.91±0.169^{c}
TCP				
0	6.52±0.053^{a}	14.17±0.888^{a}	62.66±1.908^{a}	14.32±0.188^{a}
3	6.46±0.130^{ab}	14.21±0.985^{a}	63.21±1.368^{ab}	14.20±0.228^{ab}
7	6.41 ±0.099^{abc}	14.23±0.102^{a}	65.30±1.327^{b}	13.92±0.257^{b}
10	6.36±0.156^{bc}	14.50±0.235^{b}	66.72±1.146^{c}	13.70±0.247^{c}
14	6.33±0.196^{c}	14.52±0.386^{b}	67.12±1.658^{c}	13.56±0.281^{c}

Means bearing different superscript letters within a treatment group (column) differ significantly ($p<0.05$)

Table 7: Sensory quality of chevon-pithe during refrigerated storage (Mean±SD)

Days	Appearance	Flavour	Juiciness	Texture	Overall acceptability
LCP					
0	6.93±0.146^{a}	7.23±0.418	7.25±0.221^{a}	7.23±0.144^{a}	7.09±0.204^{a}
3	6.75±0.186^{ab}	7.15±0.401	6.79±0.122^{b}	6.92±0.155^{a}	6.71±0.465^{b}
7	6.63±0.138^{bc}	7.05±0.191	6.65±0.184^{b}	6.39±0.185^{b}	6.46±0.095^{b}
10	6.52±0.266^{cd}	7.01±0.157	6.21±0.155^{c}	6.17±0.290^{bc}	6.35±0.107^{c}
14	6.42±0.218^{d}	6.98±0.283	5.94±0.176^{c}	5.92±0.572^{c}	6.20±0.291^{c}
TCP					
0	6.82±0.098^{a}	7.13±0.312	6.87±0.200^{a}	7.05±0.218^{a}	6.97±0.117^{a}
3	6.65±0.176^{ab}	7.06±0.332	6.62±0.273^{b}	6.84±0.133^{a}	6.82±0.281^{b}
7	6.52±0.245^{bc}	6.91±0.442	6.53±0.122^{b}	6.27±0.139^{b}	6.68±0.146^{b}
10	6.43±0.167^{cd}	6.82±0.261	5.81±0.205^{c}	6.01±0.151^{bc}	6.20±0.098^{c}
14	6.23±0.186^{d}	6.73±0.359	5.75±0.130^{c}	5.74±0.140^{c}	6.05±0.114^{c}

Means bearing different superscript letters within a treatment group (column) differ significantly ($p<0.05$)

The relatively low value of redness (a) of chevon pithe compared to that with conventional meat products might be due to the high proportion of rice flour in the formulation. Ali *et al.* (2011) found significantly ($p<0.05$) lower values of redness (a) in pork, chicken and duck meat with 10% addition of rice flour. Verma *et al.* (2012) suggests that addition of chickpea hull flour in low-fat chicken nuggets significantly ($p<0.05$) decreased redness, yellowness and chroma values.

Sensory analysis: The mean sensory parameters and SD values of cooked LCP and TCP samples on 0th, 3rd, 7th, 10th and 14th day of refrigerated storage are presented in Table 7. Visual appearance and texture score of both the samples remain higher up to 3rd day, after which it decreased significantly ($p<0.05$) throughout the storage. Juiciness of both the sample was affected from 3rd day onwards as scores fall significantly ($p<0.05$). No significant effect ($p>0.05$) was noticed in flavor score throughout the storage irrespective of samples. Overall acceptability score of both samples decreased significantly ($p<0.05$) on 3rd day and then unaffected up to 7th day which further deteriorated afterwards. A higher numerical value for overall acceptability of LCP sample than TCP has been noticed, suggesting the efficiency of laboratory techniques and efforts to transplant the product and its preparatory methodologies from field to laboratory and reflection of it on sensory scores. The decrease in appearance, colour and flavour scores of chevon pithe with advancement of storage period might be due to pigment and lipid oxidation (Bhat *et al.*, 2011) and increased TBA values of chevon pithe (Tarladgis *et al.*, 1960). Juiciness score had showed a significant ($p<0.05$) decreasing trend with the storage period assumed to be a fact due to some loss of moisture from the product during storage. The texture score of chevon pithe also decreased significantly ($p<0.05$) which might be attributed to the loss of moisture and breakdown of fat and protein (Bhat *et al.*, 2011). The decrease in overall acceptability might be the synergistic effect of declining of scores for all other sensory parameters.

CONCLUSION

Based on the studies, it was observed that both the chevon pithe prepared in household of Purulia district, India as well as prepared in meat laboratory, have obtained appreciable sensory score by its unique taste and quality at all the periods of refrigerated storage. Physico-chemical, microbiological and textural quality also have been retained in acceptable range throughout the storage. The preparatory method and formulation of the product is also cost effective than any

other comminuted chevon product, as almost half of the meat in the formulation is replaced by rice flour. Further research is needed on this product to modify or change the product formulation according to the taste pattern of the region and to extend product's shelf life.

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