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Effect of Chicken Breed and Lychee Peel Aqueous Extract on the Proximate and Other Properties of Generated Meat Patties

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ABSTRACT

This study was conducted to develop cobb and kadaknath chicken meat patties by incorporating Lychee fruit peel extract(LFPE) and study the effects on physicochemical and nutritional quality of developed products. Kadaknath patties had significantly higher protein percentage and less fat percentage. Cobb patties had significantly higher cooking yield than kadaknath patties. Total phenolics content of LFPR treated patties was significantly higher than control. The lightness, redness and yellowness value of kadaknath patties were significantly lower than cobb patties. The lightnesss value of LFPE treated cobb patties were significantly lower than BHT and control patties. The hardness value of kadaknath patties were non significantly higher than cobb patties. No significant difference was noticed in hardness values between control, BHT and extract treated patties. No significant difference was shown in chewiness, springiness, gumminess and cohesiveness values of kadaknath and cobb patties, No difference was shown after incorporation of LFPE. It is concluded that incorporation of 15 ml lychee peel aqueous extract per 100 g of kadaknath and cobb chicken meat resulted in the production of healthier patties with higher total phenolic content. Lychee extract provides better protection against oxidative rancidity and can be used as a replacement of synthetic antioxidants like BHT. The physic-chemical parameters did not differ majorly among kadaknath and cobb patties except for the cooking yield

HIGHLIGHTS

- The fat percentage of kadaknath patties was significantly lower and protein percentage was significantly higher than cobb patties.
- LFPE treated patties had better Total phenolics and TBA score.

Keywords: Kadaknath, cobb, proximate, lychee peel extract, TBARS, Total phenolics

Increased chicken meat demand and interest of consumers in health beneficial products are the reasons for greater efforts to estimate the nutritional and physical qualities of poultry meat. Poultry meat is considered superior for health over red meat due to its low fat and cholesterol content, unique taste, flavors its easy availability.

Despite, the plentiful availability of crossbred broiler strains, Indian consumers also prefer native chickens for taste and healthfulness of indigenous breeds. Kadaknath is a black colored chicken breed of India. Comb, Wattles and earlobes are light grey to a dark grey color.

Meat products are very good sources of proteins, vitamins and minerals. They also contain fat, saturated fatty acids,

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cholesterol, salt, etc. These are the factors which make these products susceptible to deterioration. Lipid oxidation is one of the major factors that, decide the quality and shelf-life of meat products. Synthetic antioxidants like BHT, BHA have been effectively used to prevent the oxidation problems in muscle foods (Rossi *et al*., 2013).

The synthetic antioxidants used in meat products nitrites and nitrates ascorbic acid, butylated hydroxytoluene (BHT), butylated hydroxyanisole (BHA), is involved in etiology of stomach, bowel and food allergy (Pereira *et al*., 2015). Many researchers have studied that, these substances have adverse health effects when not used within the established safety limits (Pereira *et al*., 2015).

The use of natural antioxidants in meat products appear to be good option to reduce the consumption of synthetic additives, since they are extensively used by the people without showing signs of toxicity, with performing functional activities, beneficial to human health. It is now possible to identify the presence of a variety of phenolic compounds, such as fruit extracts and industrial residues, spices and seeds (Milani *et al*., 2010; Serafini *et al*., 2012; Scapin *et al*., 2014; Qi *et al*., 2015).

Lychee chinesis is known as Chinese cherry, lychee, leechee, lichee, Litchi, mountain cherry and water lychee. It is widely harvested fruit in tropical and subtropical areas of the world. Lychee peel (LP) is reported to contain a large number and amount of phenolics which possess antioxidant, anticancer, and immune-modulatory activities. So, it is considered to be a good source of functional foods (Li *et al*., 2012; Lin *et al*., 2015).

MATERIALS AND METHODS

Procurement and processing of raw materials

Healthy cobb and kadaknath chicken reared under similar feeding and management conditions were procured from nearby market and slaughtered and dressed as per the standard procedure. The dressed carcasses were washed thoroughly and deboned manually after trimming of visible fat and connective tissue. Deboned meat was packed in colorless low density polyethylene (LDPE) bags at -18±2°C. The frozen chunks were taken out and thawed overnight at 4±2°C and used for preparation of chicken meat patties.

Lychee peels after purchase from the local market were washed gently with clean water. Peels were then squeezed through a muslin cloth and dried in a hot air drier at 50-55°C for 2-3 days. Dried peels were ground to a fine powder in a grinder, packed in a polythene bag and stored at 18±2ºC for further use. For preparing lychee peel aqueous extract, 10 g of dried powder was mixed in 100 ml of distilled water. The mixtures were incubated for overnight at room temperature and filtered through filter paper and the filtrate was used to incorporate in chicken meat patties.

Preparation of chicken meat patties

Both kinds of deboned frozen meat were cut into small pieces separately and minced in an electrical mincer. For control meat patties of both types, 100 g of minced meat of both types was taken individually in which sodium chloride (1.9 g), sodium tripolyphosphate (0.4 g), sodium nitrite (150 ppm), spice mix (2 g), condiments (3 g) (ginger and garlic in the ratio of 1:1), bread crumbs (2 g), water (10 g) egg liquid (5 g) and fat (15 g) were added and blended with the minced meat in a mixer for 4 to 5 minutes and stable emulsions were prepared. For treated meat patties 15 ml of lychee powder aqueous extract were added separately. Approximately 60 g of meat emulsion was hand moulded into a patty shape with the help of a petri dish. Patties were prepared by baking in a preheated oven at a temperature of 160°C for 35 minutes (20 minutes first side and 15 minutes second side).

Analysis

Total Phenolic content

Total phenolic content was estimated by Folin Ciocalteu's method. The data for total phenolic content were expressed as mg of gallic acid equivalent weight (GAE)/100 g of dry mass (Bhalodia *et al*., 2011).

Emulsion Stability and Water holding capacity (WHC)

Stability of control and treated emulsions were determined using the method of Baliga and Madaiah (1970). WHC was estimated according to Wardlaw *et al*. (1973).

Cooking yield

The weight of raw and cooked patties was recorded and yield was expressed as percentage by using the following formula:

$$\text{Cooking yield} = \frac{\text{Weight of the cooked patties}}{\text{Weight of raw emulsion}} \times 100$$

Proximate composition

Moisture

Finally chopped sample (30 g) was weighed in dried aluminium dish and kept in hot air oven with lid opened at 105±5°C for 16-18 h. After cooling in desiccator, loss in weight was calculated as moisture of the sample.

Crude protein

Procedure

Protein estimation of chicken patties was done by using semiautomatic instrument by Pelican Equipments, Chennai.

$$\text{Protein (\%)} = \frac{14 \times \text{Normality of acid used} \times \text{volume of acid used} \times 6.25 \times 100}{\text{Weight of sample (g)} \times 1000}$$

Fat

The fat content in cooked product was estimated by solvent extraction method (AOAC, 2005) using Socs Plus (SCS-6-AS, Pelican Industries, Chennai).

$$\text{Fat \%} = \frac{\text{Final weight of beaker } (W_2) - \text{Initial weight of beaker } (W_1)}{\text{Weight of sample}} \times 100$$

Ash

The ash content was estimated as per AOAC (2005). Ash was calculated as the difference between weight of empty crucible and weight after ashing.

Crude fibre

Crude fibre estimation was done in Fibra plus apparatus, Pelican Equipments, Chennai.

$$\text{Crude fibre (\%)} = \frac{W_2 - W_3}{W_1} \times 100$$

Where,

W_1 = Weight of sample

W_2 = Weight of insoluble matter (weight of crucible + insoluble matter – weight of crucible).

W_3 = Weight of ash (crucible + ash – weight of crucible).

Texture profile analysis

The textural properties of patties were evaluated using Texture Analyser (TA.HD plus), Stable Micro Systems Ltd., Surrey, England with the Texture Exponent Program. A compression platform of 70 mm diameter was used as a probe. The TPA was performed as per the procedure outlined by Bourne (1978).

1. Hardness (N) = maximum force required to compress the sample.
2. Springiness = ability of the sample to recover its original form after a deforming force was removed.
3. Cohesiveness = extent to which samples could be deformed before rupture (A2/A1, A1 being the total energy required for the first compression and A2 the total energy required for the second compression).
4. Gumminess (N) = hardness × cohesiveness
5. Chewiness (N) = hardness × springiness × cohesiveness

Firmness and toughness

The force required to shear a 1 cm^3 thick sample of cooked chicken meat patties transversely was analysed using Warner-Bratzler shear probe and expressed as Firmness (N) and toughness (N-sec).

Instrumental colour analysis

Colour of chicken patties was measured using a Konica Minolta chromameter CR-400 (Konica Minolta Sensing, Inc., Japan) with 8 mm aperture for measurement. The instrument was calibrated with a white standard plate. Colour scores were expressed as CIE Lab L* (lightness), a* (redness) and b* (yellowness).

pH and Thiobarbituric acid (TBA) value

The pH of chicken patties was determined with pH meter (Cyber Scan pH 510, Eutech Instruments; Thermo Fisher Scientific, Navi Mumbai) equipped with a combined glass electrode as per method of Trout *et al*. (1992). TBA value of raw emulsion and cooked patties was determined according to the method of Witte *et al*. (1970).

RESULTS AND DISCUSSION

Thiobarbituric acid (TBA) value and total phenolic content in emulsion and cooked products

The TBA value of fresh raw cobb emulsion ranged from 0.37 to 0.42 mg malonaldehyde/kg and The TBA value of fresh raw kadaknath emulsion ranged from 0.36 to 0.41 mg malonaldehyde/kg. There was no difference in TBA value of kadaknath and cobb-400 chicken meat emulsion control, BHT and LFPE treated emulsion. TBA values of cooked cobb meat patties ranged from 0.44 to 0.56. TBA values of cooked kadaknath meat patties also ranged from 0.44 to 0.56. Both kadaknath and cobb LFPE treated cooked patties had significantly lower TBA value than their respective control patties.

In a study Das *et al*. (2016) reported the initial concentration of TBARS in the control nuggets, as well as in all of the treated nuggets was between 0.31 and 0.29 mg malonaldehyde/kg, and the values were not significantly different. The significant low TBA value than control on 0 day in the study might be due variation of cultivars cultivated in the Eastern region of India and genotype differences in phenolic contents among the litchi varieties, as also reported by Li *et al*. (2012). The nuggets with 2% lychee pericarp paste showed a lower TBARS which was around 0.28 mg malonaldehyde/kg. on 0 day in goat meat patties incorporated as evaluated by Verma *et al.* (2020). Kumar (2014) reported that TBARS value of 0.51 mg malonaldehyde/kg was seen in raw ground chicken meat when incorporated lychee seed extract.

The total phenolics content of raw cobb chicken emulsion ranged from 0.11 GAE/g to 0.48 GAE/g. The total phenolics content of raw kadaknath chicken emulsion ranged from 0.13 GAE/g to 0.49 GAE/g. There was no significant difference of phenolics content between kadaknath and cobb meat patties. The phenolics values of control, BHT and LFPE treated meat emulsions of both kadaknath and cobb were significantly different. Control emulsion of kadaknath and cobb had the lowest value and treated emulsion of kadaknath and cobb had the highest value. The total phenolics in cobb cooked meat patties ranged from 0.12 GAE/g to 0.51 GAE/g. The total phenolics in kadaknath cooked meat patties ranged from 0.15 GAE/g to 0.52 GAE/g. The phenolics values of control, BHT and LFPE treated meat emulsions of both kadaknath and cobb were significantly different. Control emulsion had the lowest value and treated emulsion had the highest value.

Phenolic content of control was due to polyphenols contributed by spices and condiments added to chicken meat emulsion. Polyphenolic content and antioxidant capacity of different spices have been documented (Zheng and Wang, 2001; Pellegrini *et al*., 2006). The addition of BHT, LFPE to chicken meat resulted in a significantly higher total phenolic content. Li *et al*. (2012) reported that litchi fruit pericarp contains significant amounts of phenolics (9.39 to 30.16 mg gallic acid equivalents/g fresh weight) and exhibit diverse biological activities. Zhao *et al*. (2006) also reported a large number of polyphenolic compounds with strong antioxidant activity in the pericarp of harvested lychee fruits. LFPE had significantly higher phenolic content than BHT. Similar findings were also given by (Das *et al.*, 2016) he reported that the total phenolics content of sheep meat nuggets prepared with LFP extract was significantly higher (0.17 GAE mg/g) compared to control nuggets (0.05 GAE mg/g).

Banerjee *et al.* (2012) reported significantly higher total phenolics content in goat meat and nuggets incorporated with BHT than control nuggets.

Physico-chemical properties of raw chicken meat emulsion

The pH of both kadaknath and cobb raw emulsion and cooked chicken patties did not differ significantly between control, BHT and treatments. In cobb meat it ranged from 6.11 to 6.15 in raw emulsion and 6.23 to 6.29 in cooked

Table 1: Effect of type of meat and lychee fruit peel extract on TBA value (mg malonaldehyde/kg) and total phenolic content (mg GAE/g) of chicken meat emulsion and chicken patties. (Mean±SD) (n=6)

Treatments	TBA value (emulsion) mg malonaldehyde/kg	TBA value (Cooked) mg malon aldehyde/kg	Total phenols (emulsion) (mg GAE / g)	Total phenols (Cooked) (mg GAE/g)
C_C	$0.42^a \pm 0.16$	$0.56^a \pm 0.07$	$0.11^c \pm 0.05$	$0.12^c \pm .05$
C_{BHT}	$0.41^a \pm 0.12$	$0.54^{ab} \pm 0.10$	$0.26^b \pm 0.06$	$0.27^b \pm 0.06$
C_{LFPE}	$0.37^a \pm 0.04$	$0.44^b \pm 0.07$	$0.48^a \pm 0.06$	$0.51^a \pm 0.03$
K_C	$0.41^a \pm 0.16$	$0.56^a \pm 0.08$	$0.13^c \pm 0.06$	$0.15^c \pm 0.06$
K_{BHT}	$0.40^a \pm 0.13$	$0.52^{ab} \pm 0.11$	$0.25^b \pm 0.05$	$0.30^b \pm 0.04$
K_{LFPE}	$0.36^a \pm 0.06$	$0.44^b \pm 0.07$	$0.49^a \pm 0.06$	$0.52^a \pm 0.04$

Means with different small letter superscripts in a column differ significantly (P£0.05); C_C- Cobb control meat patty, C_{BHT}- cobb-400 commercial chicken Cobb meat patty with 100 ppm BHT, C_{LFPE}- Cobb meat patty with 15 ml of, lychee fruit peel extract; K_C- Kadaknath meat control patty, K_{BHT}- Kadaknath meat patty with 100 ppm BHT, K_{LFPE}- Kadaknath meat patty with 15 ml of, lychee fruit peel extract.

patties. In kadaknath meat it ranged from 6.14 to 6.17 in raw emulsion and 6.24 to 6.31 in cooked patties. No difference between pH value of kadaknath and cobb meat was found. Also the LFPE treatment did not affect the pH value of the patties. Similar non-significant lower pH values of meat products with BHT as compared to control were also reported by (Das *et al*., 2012) in cooked goat meat patties and Naveena (2008) in cooked chicken meat patties. The pH of fresh Lychee peel is around 5.3 and the dried one have around 4.8 (Reyes *et al*., 2016). Das *et al*. (2016) studied that sheep meat nuggets prepared with 1% LFP extract had pH value 6.20 and 1.5% LFP extract had pH value 6.22. LFP extract had no significant difference in pH value with comparison to control (pH value 6.21) and BHT (pH value 6.19) nuggets. Verma *et al*. (2020) found that the differences in the pH values of emulsions and nuggets for the control and products with lychee pericarp paste were non-significant. Nuggets with 1% LP had pH 6.17 and nuggets with 2% LP had pH value of 6.16 and control had the pH value of 6.17. Kumar *et al*. (2014) reported lower pH value of ground chicken meat incorporated with lychee seed extract. No significant difference between pH of kadaknath (pH 6.09) and cobb meat (pH 6.08) emulsion was reported by Singh *et al.* **(**2016)

Water holding capacity of cobb meat emulsion ranged from 43.75% to 44.25 %. Water holding capacity of kadaknath meat emulsion ranged from 43.66 % to 44.19 %. Water holding capacity of kadaknath meat patties had non-significantly lower values than that of cobb meat patties This might be because the water holding capacity decreases with maturity because of increased collagen content. The same results were revealed by Singh *et al.* (2016) in his study. According to Singh (2016), there is no significant difference in water holding capacity of cobb 400 and kadaknath. Kadaknath nuggets had WHC 98.11% and cobb nuggets had WHC of 98.18 %. No significant difference was noticed in water holding capacity of control, BHT, LFPE treated patties but a non-significant increase in LFPE treated patties of both kadaknath and cobb meat was shown. The slightly higher WHC might be due to the slightly lower pH value of the LFPE treated sample. According to Kumar (2014), WHC of treated ground meat with LSE was 19.52 which was better than the control group.

Emulsion stability of cobb meat patties ranged from 93.05% to 93.55 %. Emulsion stability of kadaknath meat patties ranged from 92.38% to 92.80 %.Kadaknath meat emulsion had a non-significantly lower value than that of cobb meat emulsion. The emulsion stability in commercial strain is higher. This might be due to more muscular development in commercial strain. Slightly higher emulsion stability was noticed in emulsion prepared from Cobb-400 87.04 % meat than that of kadaknath 86.99 % meat, but no significant difference was found by Singh (2016). Emulsion stability of BHT and LFPE treated patties were higher than control but no significant difference was found. Verma *et al.* (2020) suggested that there were no significant differences in the emulsion stability of control and lychee pericarp paste treated goat meat nuggets

Cooking yield of cobb meat patties ranged from 83.17% to 83.60%. Cooking yield of cobb meat patties ranged from

80.27% to 80.62%. The cooking yield of kadaknath meat patties was significantly lower than that of cobb meat patties. The higher cooking yield of cobb patties might be due to more water holding capacity and higher emulsion stability of the commercial strains. Singh *et al*. (2016) observed a significantly higher cooking yield in nuggets prepared from Cobb-400 (85.24%) meat as compared to kadaknath nuggets (84.22%). LFPE treated patties had slightly higher cooking yield as compared to control patties but no significant difference was found. The difference in cooking yield might be due to the type of cooking method and processing as reported by (Ranade, 2020). Das *et al*. (2016) reported that the addition of Lychee peel extract or BHT slight increase in cooking yield of sheep meat nuggets. The control shep nuggets had 93.62 % and nuggets with 1.5 % LFPE had 94.12% yield. Cooking losses were higher in the control groud chicken meat than groud chicken meat incorporated with lychee seed extract as reported by Kumar *et al*. (2014).

Proximate composition of cooked chicken meat patties

Chuaynukool *et al.* (2007) observed that the variation in proximate composition in the meat of different chicken breeds and correlated the changes to species, breed, muscle type, sex, age, and method of processing of carcasses.

The moisture percentage of cobb meat patties ranged from 58.81% to 59.32 %. The moisture percentage of kadaknath meat patties ranged from 58.63 % to 59.01 %. Chuaynukool *et al.* (2007) reported higher percent moisture in commercial broiler breast meat than Thai native chicken meat. Singh *et al*. (2017) reported that in moisture % in raw meat of cobb-400 and kadaknath meat no significant difference was found. The moisture percentage control and treated kadaknath and cobb meat patties incorporated with lychee fruit pericarp extract did not differ significantly from respective control and BHT. Higher moisture percentage was noticed in goat nuggets incorporated with lychee pericarp paste (64.04 %) than control (62.51 %) by Verma *et al*. (2020).

The protein content of cobb patties varied from 20.52 % to 20.99 %. The protein content of kadaknath patties varied from 23.96 % to 24.12 %. The protein percentage of kadaknath meat patties was significantly higher than that of cob meat patties. High protein content of kadaknath than Cobb-400 is probably because of the higher conversion of feed into muscle proteins. The higher protein in Thai native chicken than commercial broiler was revealed by Wattanachant *et al.* (2002). The mean Protein value of kadaknath raw is reported higher than that of cob by Singh *et al*. (2017) which was 27.25 % and 21.23 % respectively. Addition of BHT, LFPE did not result in any significant effect on protein content. There were no difference in protein contents of the control of goat meat nuggets as well as product with lychee pericarp paste, observed by Verma *et al*. (2020).

The fat percentage of cobb and kadaknath patties ranged from 16% to 16.16 %. The fat percentage of kadaknath patties ranged from 14.16 % to 14.58 %. The fat percentage of cobb meat patties was significantly higher than that of kadaknath meat patties. Higher fat percent in commercial chicken broiler meat than local chickens was reported by Ding *et al*. (1999). According to Haunshi *et al*. (2013) fat

Table 2: Effect of type of meat and incorporation of lychee fruit peel extract on physico-chemical properties of meat emulsion and cooked product (n=6)

Treatments	pH (Rawemulsion)	pH (Cooked)	Water holding capacity (%)	Emulsion stability (%)	Cooking yield (%)
C_C	6.15^a±0.04	6.29^a±0.16	43.75^a±1.33	93.05^a±0.65	83.40^a±1.01
C_{BHT}	6.12^a±0.05	6.25^a±0.14	44.08^a±1.35	93.55^a±1.36	83.17^a±1.24
C_{LFPE}	6.11^a±0.07	6.23^a±0.13	44.25^a±1.17	93.26^a±1.07	83.60^a±1.72
K_C	6.17^a±0.06	6.31^a±0.12	43.66^a±1.16	92.38^a±1.07	80.44^b±1.63
K_{BHT}	6.16^a±0.05	6.26^a±0.10	44.05^a±1.01	92.80^a±0.68	80.27^b±1.79
K_{LFPE}	6.14^a±0.04	6.24^a±0.09	44.19^a±1.52	92.65^a±0.67	80.62^b±1.71

Means with different small letter superscripts in a column differ significantly (P£0.05); C_C- Cobb control meat patty, C_{BHT}- cobb-400 commercial chicken Cobb meat patty with 100 ppm BHT, C_{LFPE}- Cobb meat patty with 15 ml of, lychee fruit peel extract; K_C- Kadaknath meat control patty, K_{BHT}- Kadaknath meat patty with 100 ppm BHT, K_{LFPE}- Kadaknath meat patty with 15 ml of, lychee fruit peel extract.

percentage in kadaknath breast meat was 3.47 and that of the thigh is 7.91 and according to Singh *et al*. (2017), the value of mean percentage of fat in raw cobb meat is higher than that of raw kadaknath meat which is 2.23and 0.97 respectively. Addition of BHT, LFPE did not result in any significant effect on fat content. As suggested by Sharma *et al*. (2019) BHT and pomegranate byproducts extract addition also did not result in any significant effect on fat content.

Ash percentage of cobb patties ranged from 1.85 % to 1.89%. Ash percentage of kadaknath patties ranged from 1.80 % to 1.84 %. No significant difference in ash content was observed between controls, BHT, LFPE treated kadaknath and cobb meat patties. The variation in our study might be due to agroclimatic conditions, type of muscle, and the processing technique. Puvaca *et al*. (2015) reported in chickens that are fed with dietary spice addition significantly difference in the ash content of the meat was found. As suggested by Jena, 2019 in kadaknath birds reared under Intensive condition breast muscle showed higher crude protein, total ash compared to thigh muscle. The effect on ash content of meat due to the age of the animal as well as geographical location and agro-climatic condition was also reported by (Kumar *et al*., 2017). Ranade *et al*. (2020) reported a difference in ash content of kadaknath meat pickle prepared by different processing techniques.

Crude fiber content of cobb patties ranged from 0.26 % to 0.28 %. Crude fiber content of kadaknath patties ranged from 0.27 % to 0.30 %. No significant difference in crude fiber content was observed between controls, BHT, LFPE treated kadaknath and cobb meat patties. As per the findings of Sharma (2019) addition of BHT, PPAE, and PABAE did not result in any significant effect on crude fiber content.

Firmness, toughness and texture profile of chicken meat patties

The texture is probably the most important quality factor associated with consumer satisfaction in the eating quality of poultry. The texture and degree of firmness of the meat are a function of the amount of water held intramuscularly. The maturity of connective tissue is a function of chemical cross bonding of the collagen in the muscle which increases with age, hence the tough meat is found in older birds as reported by Mir *et al*. (2017). The firmness and toughness values for control and treated cobb patties ranged from 8.56 N to 10.06 N and 48.77 N-sec to 49.93 N-sec respectively. The firmness and toughness values for control and treated kadaknath patties ranged from 10.12 N to 10.35 N and 49.37 N-sec to 50.12 N-sec respectively. Although the firmness value of kadaknath meat patties was higher than that of cobb meat patties but there was no significant difference between cobb and kadaknath meat patties. Addition of BHT and LFPE did not result in any significant effect on firmness and toughness of chicken patties.

The hardness values for control and treated cobb patties ranged from 38 N to 39.55 N. The hardness values for control and treated kadaknath patties ranged from 40.48

Table 3: Effect of type of meat and incorporation of lychee fruit peel extract on proximate composition of meat patties (Mean±SD) (n=6)

Proximate composition Treatments	Moisture (%)	Protein (%)	Fat (%)	Ash (%)	Crude fibr (%)
C_C	$58.81^a \pm 0.82$	$20.52^a \pm 0.74$	$16.00^a \pm 0.70$	$1.85^a \pm 0.38$	$0.26^a \pm 0.03$
C_{BHT}	$58.84^a \pm 0.83$	$20.77^a \pm 0.51$	$16.16^a \pm 0.81$	$1.89^a \pm 0.44$	$0.28^a \pm 0.02$
C_{LFPE}	$59.32^a \pm 0.85$	$20.99^a \pm 0.59$	$16.08^a \pm 0.80$	$1.87^a \pm 0.37$	$0.30^a \pm 0.04$
K_C	$58.63^a \pm 1.01$	$23.96^b \pm 0.59$	$14.16^b \pm 0.25$	$1.84^a \pm 0.39$	$0.27^a \pm 0.02$
K_{BHT}	$58.65^a \pm 1.0$	$24.01^b \pm 0.76$	$14.58^b \pm 0.49$	$1.82^a \pm 0.39$	$0.28^a \pm 0.03$
K_{LFPE}	$59.01^a \pm 0.9$	$24.12^b \pm 0.63$	$14.41^b \pm 0.37$	$1.80^a \pm 0.27$	$0.30^a \pm 0.04$

Means with different small letter superscripts in a column differ significantly (P£0.05); C_C- Cobb control meat patty, C_{BHT}- cobb-400 commercial chicken Cobb meat patty with 100 ppm BHT, C_{LFPE}- Cobb meat patty with 15 ml of, lychee fruit peel extract; K_C- Kadaknath meat control patty, K_{BHT}- Kadaknath meat patty with 100 ppm BHT, K_{LFPE}- Kadaknath meat patty with 15 ml of, lychee fruit peel extract.

N to 42.65 N. The hardness values of kadaknath patties were non significantly higher than that of cobb patties. No significant difference was noticed in hardness values between control, BHT and extract treated patties. Tang *et al.* (2009) suggested that the difference in shear force is according to the age of the birds. According to Singh *et al*. (2017) the mean shear force value of cobb was non significantly higher (8.43 N) than that of kadaknath (9.74 N) as well for the mean shear energy values the shear energy for cobb cooked meat was significantly higher than the kadaknath cooked meat.

No significant difference was observed in springiness values and cohesiveness of control and treated patties. Gumminess values and chewiness values of Kadaknath patties were non significantly higher as compared to cobb meat patties and LFPE treated patties have a lower value of chewiness but no significant difference was found. The lower hardness value for the product with LFPE could be due to the softness of meat products on account of moisture and fat retention while cooking, which is also evident from the proximate composition of the product. Verma *et al*. (2020) suggested that the analysis of textural properties of all the treatments revealed that incorporation of lychee pericarp in the product formulation decreased the hardness and gumminess and treatment LP-II i.e. 2 % of LP, had significantly lower values than control. However, hardness and gumminess values of the control and treatment LP-I i.e. 1 % of lychee pericarp paste did not differ significantly. Other textural properties like adhesiveness, springiness, cohesiveness and chewiness values among three products did not differ significantly.

Instrumental color analysis

The L* values of cobb patties ranged from 52.89 to 56.50 for control and treated patties. The L* values of kadaknath

Table 4: Effect of type of meat and incorporation of lychee fruit peel extract on firmness (N) and toughness (N-sec) of chicken meat patties (Mean±SD) (n=6)

Treatments	**Firmness (N)**	**Toughness (N-sec)**
C_C	$8.56^a\pm0.48$	$49.93^a\pm2.21$
C_{BHT}	$9.36^a\pm1.54$	$48.77^a\pm4.02$
C_{LFPE}	$10.06^a\pm1.83$	$49.10^a\pm3.81$
K_C	$10.12^a\pm0.75$	$50.12^a\pm3.44$
K_{BHT}	$10.29^a\pm1.87$	$49.37^a\pm3.54$
K_{LFPE}	$10.35^a\pm1.16$	$50.04^a\pm3.36$

Means with different small letter superscripts in a column differ significantly (P£0.05); C_C- Cobb control meat patty, C_{BHT}- cobb-400 commercial chicken Cobb meat patty with 100 ppm BHT, C_{LFPE}- Cobb meat patty with 15 ml of, lychee fruit peel extract; K_C- Kadaknath meat control patty, K_{BHT}- Kadaknath meat patty with 100 ppm BHT, K_{LFPE}- Kadaknath meat patty with 15 ml of, lychee fruit peel extract.

Table 5: Effect of type of meat and incorporation of lychee fruit peel extract on TPA of meat patties (Mean±SD) (n=6)

Treatments	**Hardness (N)**	**Springiness**	**Cohesiveness**	**Gumminess (N)**	**Chewiness (N)**
C_C	$38.82^a\pm3.01$	$0.86^a\pm0.04$	$0.52^a\pm0.12$	$20.28^a\pm4.9$	$17.51^a\pm3.95$
C_{BHT}	$39.55^a\pm2.58$	$0.84^a\pm0.04$	$0.52^a\pm0.11$	$20.72^a\pm4.43$	$17.45^a\pm3.31$
C_{LFPE}	$38.00^a\pm3.64$	$0.84^a\pm0.03$	$0.49^a\pm0.09$	$18.88^a\pm4.15$	$15.85^a\pm3.26$
K_C	$42.48^a\pm4.09$	$0.88^a\pm0.06$	$0.50^a\pm0.09$	$21.60^a\pm4.78$	$19.07^a\pm4.35$
K_{BHT}	$42.65^a\pm4.17$	$0.87^a\pm0.10$	$0.52^a\pm0.10$	$22.32^a\pm4.48$	$19.49^a\pm4.33$
K_{LFPE}	$40.48^a\pm4.26$	$0.87^a\pm0.05$	$0.49^a\pm0.09$	$19.96^a\pm4.24$	$17.43^a\pm4.17$

Means with different small letter superscripts in a column differ significantly (P£0.05); C_C- Cobb control meat patty, C_{BHT}- cobb-400 commercial chicken Cobb meat patty with 100 ppm BHT, C_{LFPE}- Cobb meat patty with 15 ml of, lychee fruit peel extract; K_C- Kadaknath meat control patty, K_{BHT}- Kadaknath meat patty with 100 ppm BHT, K_{LFPE}- Kadaknath meat patty with 15 ml of, lychee fruit peel extract.

patties ranged from 37.98 to 39.41 for control and treated patties. In cobb patties incorporation of LFPE resulted in an increase in darkness and treatment LFPE had significant lower lightness scores in comparison to control and BHT. Kadaknath meat patties had significant lower lightness score as compare to cobb meat patties but effect of LFPE was not seen. The lightness value of the meat products is determined by their ability to scatter light which in turn is influenced by the sizes of the various particles present in the matrix as well as their distribution (Das *et al.,* 2015). The black color of kadaknath is due to the deposition of melanin, a genetic condition called "Fibromelanosis" (GI Journal No. 104. 2018), (Pathak *et al.,* 2015). The same results were also reported by Singh (2017). The variation in L*, a*, and b* values among different breeds/strain in the study could also be due to the deposition and absorption of these pigments. Meat color is affected by animal species; age, diet type, type of muscle fiber, and the exercise that animal undertake (Lyons *et al*., 2001).

The a* values ranged from 4.21 to 4.61 for control and treated cobb meat patties. The a* values ranged from 1.55 to 1.64 for control and treated kadaknath meat patties. The b* values ranged from 1.75 to 11.38 for control and treated kadaknath and cobb meat patties. No significant difference was observed in a* and b* values between any of the treatments of cobb meat patties. The a* value of kadaknath meat patties were significantly lower than that of cobb meat patties. No significant difference was observed in a* and b* values between any of the treatments of kadaknath meat patties.

Variation in a* value and b* value in between kadaknath and cobb patties were in favor of the results reported by Singh (2017).

According to Verma *et al.* (2020) incorporation of LP significantly affected the color profile of the products. Treatments with added LP showed significantly lower hunter color lightness values while higher redness value with respect to the control. The yellowness value of products decreased due to added lychee pericarp paste. Kumar *et al*. (2014) reported that LSE treatment resulted in the darkness of the meat samples. The redness (a*) was increased in treatment. The yellowness (b*) was increased in treatment. The difference in a* and b* value might be because the lychee peel extract has a lighter color than that of lychee seed extract and the more concentrated paste incorporation affects the colour affects more than that of extract incorporation.

Table 6: Effect of type of meat and incorporation of lychee fruit peel extract on instrumental color of chicken meat patties (Mean±SD) (n=6)

Treatment	L*	a*	b*
C_C	56.50^a±1.88	4.21^a±0.66	11.28^a±0.60
C_{BHT}	55.40^a±2.13	4.53^a±0.93	11.38^a±0.48
C_{LFPE}	52.89^b±1.92	4.61^a±0.89	11.28^a±0.56
K_C	38.41^c±1.49	1.55^b±0.52	1.79^b±0.92
K_{BHT}	39.41^c±2.96	1.61^b±0.60	1.81^b±0.99
K_{LFPE}	37.98^c±1.40	1.64^b±0.66	1.75^b±0.90

Means with different small letter superscripts in a column differ significantly (P£0.05); C_C- Cobb control meat patty, C_{BHT}- cobb-400 commercial chicken Cobb meat patty with 100 ppm BHT, C_{LFPE}- Cobb meat patty with 15 ml of, lychee fruit peel extract; K_C- Kadaknath meat control patty, K_{BHT}- Kadaknath meat patty with 100 ppm BHT, K_{LFPE}- Kadaknath meat patty with 15 ml of, lychee fruit peel extract.

CONCLUSION

The study concluded that incorporation of 15 ml lychee peel aqueous extract per 100 g of kadaknath resulted in the production of healthier patties than cobb-400 meat patties with significantly higher protein and significantly lower fat percentages. Lychee peel extract-treated patties had no significant difference in physicochemical and nutritional qualities. However, LFPE treated patties had better Total phenolics and TBA score which will help in protection against oxidative rancidity and microbial spoilage during storage and can be used as a deserving substitute for synthetic antioxidants like BHT.

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