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Research Article

EFFECT OF DIFFERENT LEVELS OF BAKING POWDER ON THE PHYSICO-CHEMICAL AND SENSORY ATTRIBUTES OF CHICKEN MEAT CARUNCLES

PARMINDER SINGH[1]*, JHARI SAHOO[1], MANISH K. CHATLI[1] and ASHIM K. BISWAS[2]
[1]Department of Livestock Products Technology, College of Veterinary Sciences
Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana-141 004
[2]Division of Post-Harvest Technology, CARI, Izatnagar, Bareilly-243 122

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ABSTRACT

The present study was conducted to determine the effects of different levels of baking powder on the physico-chemical and sensory attributes of chicken meat caruncles (CMC). Four different variants along with control samples were prepared viz. C=Control (without baking powder, B.P.), T-1=0.4% B.P., T-2=0.5% B.P., T-3=0.7% B.P. and T-4=0.9% B.P. Cooking yield and moisture % of CMC increased significantly ($P<0.05$) with an increase in the level of baking powder. Hardness was significantly higher ($P<0.05$) in T-1 and T-2 samples of CMC. Water activity (a_w), adhesiveness, adhesive force and stringiness did not differ significantly between control and treated samples. *L* values were non-significantly higher in all the treatments. Among sensory attributes, overall acceptability was significantly higher ($P<0.05$) and all other characteristics (colour/appearance, flavour, crispiness, after-taste and meat flavour intensity) were non-significantly higher in T-2 batch of CMC. Chicken meat caruncles prepared using 65% spent hen meat and 0.5% baking powder possessed all the sensory attributes in favourable range along with marginally higher cooking yield, moisture, hardness and crispiness.

Key words: Chicken meat caruncles, baking powder, physico-chemical parameters, sensory attributes

Poultry meat sector is one of the fastest growing sectors of livestock economy. Chicken meat and its products have experienced increasing popularity and become widely spread all over the world. Chicken meat is higher in protein content, but low in fat and calories and also has a great appeal because of its flavour, texture and delicacy. The processing of meat into different ready-to-eat value added products is also increasing due to urbanization and the growth of fast food sector. Cereal based snacks usually lack some essential amino acids like threonine, lysine and tryptophan (Jean *et al.*, 1996), so incorporation of meat into them greatly enhances their nutritive value especially with respect to amino acids, flavour and taste (Park *et al.*, 1993). The world's snack food market including semi-processed/cooked and ready to eat foods was valued at Rs 82.9 billion in 2004-05 and is increasing with a growth rate of 20%. However, in India snack food market has reached a value of Rs. 1530 crores and is expected to grow at 9 to 12% during the tenth five-year plan (Singh *et al.*, 2011). Various scientific studies have reported the development of shelf-stable meat snacks viz. shelf-stable chicken meat caruncles (Singh *et al.,* 2012), popped cereal snacks (Lee *et al.*, 2003), chicken chips (Sharma and Nanda, 2002), meat papads (Berwal *et al.*, 1996) etc.

In extruded snack foods, the quality evaluation seems to be correlated with sensory, instrumental and microstructure characteristics which all together will account for a product with high acceptability (Anton and Luciano, 2007). Commercially available baking powder is a dry leavening agent, a mixture of weak alkali (sodium bicarbonate), a weak acid (such as cream of tartar) and an inert starch (corn or potato starch). It acts as a source of carbon dioxide causing the bubbles in the wet mixture to expand and thus leavening the mixture. In snacks, it increases the volume and crispiness and lightens their texture without compromising the original features (Helmenstine, 2013). The use of baking powder is common in cereal snacks (Glabe *et al.*, 1984). However there is limited availability of structured information on its use in meat snacks. Therefore, the present study was envisaged with an objective to study the effects of different levels of baking powder on the physico-chemical and sensory attributes of chicken meat caruncles (CMC).

MATERIALS AND METHODS

Preparation of CMC: White Leghorn layer spent hens

*Corresponding author: pssandhulpt@gmail.com

(80-100 weeks old) were slaughtered as per standard procedure in the experimental slaughter house. After manual deboning, the meat cubes were tenderized as per the method described by Biswas *et al.* (2009) by dipping in a solution containing 0.25% papain (w/w) and 0.15 M calcium chloride (w/v) for about 36-40 h at refrigeration temperature (4±°C). Thereafter the meat cubes were rinsed thoroughly 2-3 times in running water and extra moisture was drained out. These were then packed in low density polyethylene (LDPE) bags and kept at -18±1°C for subsequent use. Frozen tenderized meat sample was taken out as per requirement and cut into smaller cubes after partial thawing in a refrigerator (4±1°C). The meat chunks were then double minced using 6 mm and 4 mm grinder plates (KL-32, Kalsi, Ludhiana, India) to get fine tenderized minced chicken meat (TMCM).

Spice mix was prepared by grinding dried (45±2ºC for 2 hrs) ingredients viz. 15% coriander, 15% cumin seeds, 10% caraway seeds, 10% aniseed, 10% black pepper, 8% red mirch powder, 8% dry ginger powder, 5% cinnamon, 5% clove, 5% cardamom large, 5% mace, 2% nutmeg and 2% cardamom small to a fine ground powder using Inalsa mixer (Inalsa Maxie plus, 07120219, Inalsa Technologies, New Delhi, India) and sieved through a fine mesh.The chicken meat emulsion was prepared by blending 65% TMCM with 1% common salt (TATA salt, Tata chemicals Ltd. Mumbai) and 1% sugar and mixed in Inalsa mixer for 1 min, followed by mixing of different levels of baking powder (Ajanta Baking powder, Ajanta Food Products Co., Solan, India; Code No. 288668) viz. control (C)=0%, T-1=0.4%, T-2=0.5%, T-3=0.7% and T-4=0.9% baking powder. Thereafter, 0.7% carboxymethyl cellulose (Sodium salt high viscosity carboxymethyl, S.D. Fine-Chemicals Limited, Mumbai, India), 2% spice mix, 35% refined wheat flour and 5% refined soyabean oil was added by mixing simultaneously in the mixer. Thereafter, with the help of a manually operated stainless steel extruder, the prepared chicken meat emulsion was extruded in the form of thin chip like caruncles in a microwave plate. Cooking was done by putting this plate (filled with raw CMC) in a microwave oven (Inalsa microwave oven, New Delhi, India) for 4 minutes (2.0 minutes on one side and 2.0 minutes on the other side). The cooked CMC were kept in pearl polyethylene terepthalate (PET) jars and thereafter analyzed for different physico-chemical and sensory attributes.

Physico-Chemical Parameters:

Cooking yield (%): Cooking yield was calculated by dividing the weights of raw and cooked CMC before with that of after cooking, multiplied by 100.

Moisture (%): The moisture content in CMC (n=6) was determined using an automatic moisture analyzer (Essae, AND MX-50). Finely ground CMC (<5gm) were kept in a sample plate for 10-12 min for final reading. All samples were analyzed in duplicate.

Water Activity (a_w): Water activity was determined using portable digital water activity meter (Rotonix HYGRO Palm AW1 Set/40, 60146499). Finely ground CMC is filled up (80%) in a moisture free sample cup over which the sensor was placed for five min and reading was noted.

pH: The pH was determined as per the method described by Trout *et al*. (1992) with a digital pH meter (SAB 5000, LABINDIA, New Delhi, India). For this, 10 g of sample was homogenized with 50 ml of distilled water and the electrode was dipped into the suspension to note down the pH.

Texture Profile Analysis: Texture profile analysis was conducted as per the procedure outlined by Bourne (1978) using Texture Analyzer (TMS-PRO, Food Technology Corporation, USA). Each CMC was subjected to pretest speed (30mm/sec), post test speed (100mm/sec) and test speed (100mm/sec) to a single Warner-Bratzler shear blade with a load cell of 2500 N. Parameters like hardness [peak force of the first compression cycle (Newton; N)], adhesiveness [The negative area for the first bite, representing the work necessary to pull the compressing plunger away from the sample (milli Joules; mJ)], adhesive force [Maximum negative force generated during upstroke of probe (Newton; N)] and stringiness [Distance to peak negative force from point where load crosses zero value in decompression cycle (millimeter; mm)] were calculated automatically by the preloaded Texture Pro software in the equipment from the force-time plot.

Colour Profile Analysis: Colour profile was measured on a set of three cooked CMC (placed in a plate) using Lovibond Tintometer (Lovibond RT-300, Reflectance Tintometer, UK) set at 2° of cool white light (D_{65}) and known as *L*, *a*, and *b* values. The Hue (relative position of colour between redness and yellowness) and Chroma (Intensity, brightness or vividness of colour) were determined by using formula given by Little (1975).

$$\text{Hue} = (\tan^{-1})\ b/a$$

$$\text{Chroma} = [a^2 + b^2]^{0.5}$$

Sensory Evaluation: A seven member experienced panel of judges from the pool of teachers and postgraduate students of College of Veterinary Sciences, Guru Angad Dev Veterinary and Animal Sciences University evaluated the CMC for sensory attributes viz. colour and appearance, flavour, crispiness, after-taste, meat flavour intensity and overall acceptability following 8- point hedonic scale (Keeton, 1983 with slight modification) where 8=extremely desirable and 1=extremely undesirable. Three replicates (n=21) were conducted.

Statistical Analysis: Experiment was carried out thrice in duplicates (n=6) and data were analyzed using SPSS-16.0 software package (SPSS Inc. Chicago, IL, USA) as per standard procedures (Snedecor and Cochran, 1994) for analysis of variance using Duncan's Multiple Range Tests and Homogeneity tests to test the significance of difference between means at 5% level (P<0.05) of significance.

RESULTS AND DISCUSSION

Physico-chemical Quality: Perusal of Table 1 revealed that there was a continued and significant (P<0.05) increase in cooking yield of CMC as the level of baking powder increased. The highest cooking yield of 55.50% was observed in T-4 samples. The observation was in agreement with the results of Omana *et al*. (2010) who also reported that at higher pH, cooking and water losses were significantly decreased hence, cooking yield increased in chicken dark meat. Moisture also significantly increased (P<0.05) as the level of baking powder increased in the formulation, but there was no significant difference between moisture levels of T-3 and T-4. This might be due to moisture retention properties of sodium bicarbonate in baking powder. Higher cooking yields in T-3 and T-4 could be due to their respective increase in moisture % levels. Water activity (a_w) showed no significant difference between control and four treated variants. This might be due to the fact that water activity is an inherent property of foods which indicates the amount of water available to microbes for their growth and is directly responsible for microbiological safety of the foods (Gibbs and Gekas, 2010). The pH of T-1 sample (6.07) was significantly higher (P<0.05) than control (5.95) but there was no significant difference between pH of T-2, T-3 and T-4 samples. The higher pH in T-1 was due to sodium bicarbonate content of baking powder than control samples. The results were in agreement with the findings of Sen *et al*. (2005).

In texture profile analysis, hardness increased significantly (P<0.05) with the increase in the level of baking powder in the formulation (Table 1). Hence, it was significantly higher in T-1 and T-2 than control. T-2 exhibited maximum hardness among all the treated samples. Similar results were reported by Omana *et al*. (2010) in chicken dark meat. But there was no significant

Table 1
Effect of different levels of baking powder on the physico-chemical properties of chicken meat caruncles

Profile	Parameters	Groups				
		C	T-1	T-2	T-3	T-4
Physico-chemical	Cooking yield (%)	52.14±0.25^a	52.63±0.00^b	53.50±0.00^c	54.33±0.17^d	55.50±0.00^e
	Moisture (%)	6.59±0.04^a	6.72±0.01^b	8.37±0.04^c	10.27±0.01^d	10.32±0.04^d
	Water activity (a_w)	0.56±0.00^a	0.58±0.00^a	0.61±0.00^a	0.61±0.00^a	0.62±0.00^a
	pH	5.95±0.01^a	6.07±0.07^b	6.34±0.01^c	6.37±0.01^c	6.40±0.01^c
Texture profile	Hardness (N)	89.87±6.50^a	128.77±5.90^b	162.97±12.60^c	104.27±2.20^a	87.67±2.22^a
	Adhesiveness (mJ)	47.57±22.16^a	23.50±6.86^a	18.66±5.39^a	8.47±0.71^a	55.66±20.48^a
	Adhesive force (-ve N)	3.67±1.87^a	5.10±2.31^a	6.97±4.29^a	5.50±2.29^a	5.87±3.74^a
	Stringiness (mm)	1.20±0.60^b	0.20±0.20^a	0.02±0.02^a	0.00±0.00^a	0.00±0.00^a
Colour profile	*L*	24.30±1.98^a	28.83±1.43^{ab}	38.29±6.60^b	35.20±2.84^{ab}	27.86±4.80^{ab}
	a	9.04±0.12^{ab}	7.34±0.43^a	9.55±1.43^{ab}	10.15±0.60^b	8.91±0.41^{ab}
	b	16.54±0.28^a	17.39±1.68^a	23.34±2.72^b	21.73±1.12^{ab}	17.74±1.37^a
	Hue angle	61.33±0.64^a	66.97±0.84^b	67.92±0.79^b	64.83±2.30^{ab}	63.11±2.31^{ab}
	Chroma	18.85±0.23^a	18.88±1.71^a	25.22±3.06^b	24.02±0.82^{ab}	19.88±1.18^{ab}

Mean±S.E. with different superscripts in a row differ significantly (P<0.05).C=Control (without baking powder); T-1=0.4% baking powder; T-2=0.5% baking powder; T-3=0.7% baking powder and T-4=0.9% baking powder

Table 2
Effect of different levels of baking powder on the sensory attributes of chicken meat caruncles

Parameters	Groups				
	C	T-1	T-2	T-3	T-4
Colour/Appearance	6.33±0.17[a]	6.33±0.33[a]	6.83±0.17[a]	6.50±0.00[a]	6.33±0.17[a]
Flavour	6.33±0.33[a]	6.33±0.17[a]	6.67±0.17[a]	6.33±0.17[a]	6.17±0.17[a]
Crispiness	6.33±0.33[a]	6.67±0.17[a]	6.83±0.17[a]	6.50±0.29[a]	6.17±0.17[a]
After-taste	6.67±0.33[a]	6.83±0.44[a]	7.50±0.29[a]	6.83±0.17[a]	6.67±0.17[a]
Meat flavour intensity	7.17±0.17[a]	6.83±0.17[a]	6.67±0.33[a]	6.33±0.17[a]	6.33±0.33[a]
Overall acceptability	6.50±0.29[a]	6.83±0.44[a]	7.83±0.17[b]	6.67±0.17[a]	6.67±0.17[a]

Mean±S.E. with different superscripts in a row differ significantly (P<0.05). C=Control (without baking powder); T-1=0.4% baking powder; T-2=0.5% baking powder; T-3=0.7% baking powder and T-4=0.9% baking powder

difference of hardness between control, T-3 and T-4. This might be due to higher level of moisture in T-3 and T-4 samples. Overall the hardness values ranged from 87.67-162.97 N. There was no significant difference of adhesiveness and adhesive force between control and treated CMC. It seems that the effect of baking is minimal on these textural attributes. However, stringiness was significantly higher (P<0.05) in control (1.20) than treated samples (0.00-0.20).

In colour profile analysis, *L* values ranged from 24.30-38.29 and were found to be non-significant although it remained marginally higher in all the treated variants than the control CMC (Table 1). The *a* value of control, T-2 and T-4 samples did not differ significantly among themselves. The *b* value was also non-significant between different variants. Hue angle and chroma also showed similar patterns. All the colour profile parameters showed an increasing trend (except *a* value) till T-2 and declining trend afterwards. The highest values were achieved in T-2 samples. It indicated that 0.5% level of baking powder produced somewhat better colour and appearance of product than the other groups. These results were in agreement with the sensory scores of T-2 samples which remained the highest among all the variants.

Sensory Quality: Data pertaining to different sensory attributes of CMC viz. colour, flavour, crispiness, after-taste, meat flavour intensity and overall acceptability are presented in Table 2. All the sensory attributes except overall acceptability remained non-significant and were not affected by different levels of baking powder. However, the sensory panel gave highest sensory scores to T-2 batch than the control and other treated groups. The scores of crispiness followed similar trends to that of hardness values. The highest value of crispiness (6.83) was due to maximum hardness (162.97 N) in T-2, which is favorable and acceptable attribute for snacks. Overall acceptability was also significantly highest (P<0.05) in T-2 batch of CMC than all the other variants. These observations corresponded to the results of texture and colour profile parameters described above.

The present study revealed that addition of 0.5% baking powder in CMC showed highest sensory scores for all the attributes than that of non-addition sample. Also it imparted desirable colour to product in addition to increase in cooking yield, moisture and pH than the control groups. Therefore, meat industry can effectively utilize 0.5% baking powder for development of good quality meat snacks.

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