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Effect of Different Cooking Methods on the Quality Attributes of Chicken Meat Cutlets

Tejinder Singh, Manish Kumar Chatli, Pavan Kumar*, Nitin Mehta and Om Prakash Malav

Department of Livestock Product Technology, College of Veterinary Science, Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana, Punjab, INDIA

**Corresponding author: P Kumar; Email: vetpavan@gmail.com*

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ABSTRACT

Present study was envisaged to assess the effect of various cooking methods viz. deep fat frying, oven cooking, air frying, and oven cooking followed by shallow frying for preparation of chicken meat cutlets. Three different treatments as per pre-standardized formulations viz. Control, T1 (chicken meat cutlets with 30% meat emulsion) and T2 (with 3% refined wheat flour) were cooked by various cooking methods and subjected to various physico-chemical, instrumental colour and textural attributes, and sensory quality attributes. Under deep fat frying and oven cooking, cooking yield of treatments were recorded significantly ($P<0.05$) higher than control. Treatments scored better on various dimensional parameters such as increase in height, decrease in length and decrease in breadth irrespective of different cooking methods. The increase in height was recorded highest for T2 irrespective of cooking methods. The fat percent for T1 and T2 was recorded significantly ($P<0.05$) higher for deep fat frying (T1) and combination of oven and shallow frying. Flavour scores had been significantly ($P<0.05$) improved for T2, whereas T1 and C were comparable under different cooking methods. T2 showed significantly ($P<0.05$) higher overall acceptability scores than C and T1. Thus oven cooking followed by shallow frying was found optimum for preparation of chicken cutlets.

Keywords: Chicken meat cutlets, cooking methods, quality attributes

There is continuously growing demand of snacks foods worldwide due to rapid urbanization, industrialization, changing lifestyle etc (Verma *et al.,* 2012). Cutlets are flat croquette of flour, pulse, nuts, potato, condiments, spices and often coated with bread rusk crumbs and are considered as one of the most popular snack based products (Singh *et al.,* 2014a;b). The nutritive value of cutlets can be further enhanced by incorporating meat. Meat cutlets are ready-to-eat convenient meat product, served hot, with or without mouth watering substances like chutney.

Cooking has been considered as a very critical step in the preparation of food products affecting nutritive value, organoleptic properties thus consumer acceptance. For cooking of meat products such as cutlets, frying, oven and microwave cooking are mostly practiced (Singh *et al.,* 2012). There is continuously growing interest of consumers towards air fried cutlets. Colour development of the enrobed products such as cutlets depends with the amount and composition of the batter, cooking temperature and time, cooling media characteristics etc. The breading on the fried meat has been reported to enhance the texture, flavour and appearance of the product. Adhesion is a critical characteristic for battered products and the main factors affecting adhesion of batter to food products are properties of food used, battering ingredients and cooking methods (Mukprasirt *et al.*, 2000). Functionality of ingredients in batter on moisture retention and fat barrier properties during deep fat frying is not clearly understood.

The effect of additives and microwave cooking on quality of spent hen chicken meat patties was studied by Sharma *et al.* (2005) and that microwave unpacked cooked chicken meat patties had lower moisture, less juiciness and harder texture than LDPE packed oven cooked patties. However, microbial destruction was same in microwave cooking as that of LDPE cooking. The effects of microwave oven cooking on the quality of chicken patties prepared from minced chicken meat, chicken fat, spice and condiment mixture, sodium nitrate, sodium nitrite, sodium tripolyphosphate, monosodium glutamate, refined wheat flour, chilled water and salts was studied by Nath *et al*. (1996). It was found that microwave oven cooked patties had higher pH, lower protein, lower fat contents and higher cooking yields than cooked patties but significantly lower overall acceptability than cooked samples.

The influence of different cooking methods pan frying, and microwave oven on chevon patties with and without added fat, whey protein concentrate and flavour was studied by Pawar *et al*. (2000). Significant differences were observed for product yield, cooking loss, gain in height, reduction in diameter, moisture, protein, fat and sensory attributes between different cooking methods. With added flavours microwave oven cooking and without added flavours, pan frying method was found to be the most suitable. Deep fat frying of the coated meat products helps in achieving an acceptable texture, flavour and appearance. The temperature and time of frying is important, as the overheated product, gives a dry sensory perception. Fat absorption was also high for deep fat frying when compared to oven frying and skillet frying.

Deep fat frying is popular in commercial establishments. Less moisture loss occurred at lowest temperature frying than at high temperature, but percent yield did not vary with temperature, probably results of imprecision associated with breading or frying procedures i.e. breading fall off before, during and after frying (Lane *et al.*, 1982). Decreased yields of chicken cooked entirely by frying at a temperature above 185°C was observed (Yand and Chen, 1979), less cooking loss in breaded steam cooked chicken compared to unbreaded water cooked parts. This effect was thought to be due to the protective coating given by the breading, which may have sealed in or soaked up juices normally lost in the steam cooking process (Love and Goodwin, 1974). Thus the present study was undertaken to assess the effect of various cooking methods on the development of chicken meat cutlets

MATERIALS AND METHODS

Source of materials

The White Leghorn layer birds of 58-60 weeks old (spent hen) were procured from university poultry farm and were slaughtered scientifically in the experimental slaughterhouse of the Department under strict hygienic conditions. The dressed carcasses were hot deboned and stored overnight in refrigerator (4±1ºC) in low density polyethylene film (LDPE) bags for conditioning and followed by storing at -18±1ºC for subsequent use. The frozen deboned meat was thawed overnight in a refrigerator (4±1ºC) and used for further study.

The ingredients for spice mix were procured from local market, cleaned, dried and grinded to fine powder. The spice mix was prepared by mixing different spices ingredient as per the pre standardized formulation developed in laboratory as per Verma *et al*. (2015a). The condiment mix was prepared by mixing onion, ginger and garlic paste, respectively in 3:1:1 ratio. Bread crumbs and whole egg liquid were used as breading and battering material.

Methodology for Preparation of chicken cutlets

Meat was minced through 6 mm plate in meat mincer (Mado Eskimo Mew-714, Mado, Germany). The condiments, cooked shredded potato, spice mix, refined oil, salt, red chillies, refined wheat flour, meat emulsion, minced meat was added as per the formulation in the minced meat (Table 1). In the standardized formulation, lean meat was replaced by 30% meat emulsion (T1) and 3% refined wheat flour (T2) replacing lean meat. For the preparation of meat cutlet, three batches (one control and two treatments) of batter were prepared by thoroughly mixing all the ingredients. The batter was moulded (oval shaped) using a mould of dimensions of 59 × 40 ×19 mm, length, breath and height respectively. The cutlets were then pre cooked under preheated hot air oven for 175ºC for 15 minutes, with turning once after ten minutes. Cutlets were cooled and dipped into whole egg liquid until uniform coating is formed. The battered cutlets were rolled over the bread crumbs until uniform coating of breading material was formed over it. The breaded cutlets were cooked under different cooking methods (Table 2). The cooked cutlets were cooled, weighted, packed and put for further analysis.

Table 1: Formulation of chicken meat cutlets.

Name of ingredients (Percentage w/w)	Control	T1	T2
Chicken meat (Minced)	71.0	41.0	68.0
Chicken meat emulsion	-	30.0	-
Cooked shredded potato	10.0	10.0	10.0
Condiment mix (3:1:1)	10.0	10.0	10.0
Refined Oil	2.0	2.0	2.0
Salt	1.5	1.5	1.5
Red chilli powder	0.5	0.5	0.5
Spice mix	2.0	2.0	2.0
Refined wheat flour	3.0	3.0	6.0

Table 2: Different cooking methods with their time-temperature combination.

Cooking methods	Temperature (°C)	Time (minutes)
Deep fat frying	165-170	15-20
Air frying	180	25
(Philips HD9220)		
Oven cooking	180	25
Oven cooking + Shallow frying (Combination)	175±5 (oven cooking)	20
	140-150 (Shallow frying)	Till golden brown

Physico-chemical analysis

Cooking yield of samples was determined by measuring the difference in the sample weight before and after cooking (Murphy *et al.*, 1975).

The pH of chicken meat cutlet was measured as per the procedure of Trout *et al.* (1992) using combined glass electrode of Elico pH meter (Model LI 127).

The dimensional parameters of the patties were measured by vernier calliper at three different places. The percent gain in height and decrease in breath/length percent were determined as per the following equation-

Water activity was determined using potable digital water activity meter (Rotronix HYGRO Palm AW1 Set, Rotronix Instrument (UK) Ltd., West Sussex, UK). Briefly, finely ground meat samples were filled up (80%) in a moisture free sample cup.

Colour profile was measured using Lovibond Tintometer (Model: RT-300). 'L' value denotes (brightness 100) or lightness (0), a (+ redness/- greenness), b (+ yellowness/-blueness) values. The instrument was calibrated using a black hole and white tile. The instrument was directly put on the surface of meat cutlets at different points and readings were noted.

Texture profile analysis (TPA) of sample was performed using a Texture Analyser (TMS-PRO, Food Technology Corporation, USA) following the procedures of Bourne (1978). The cutlets were cut into uniform cube size of 1.0×1.0×1.0 cm. and subjected to double compression cycle to 50% of their original height using pre-test speed was 5mm/s, test speed was 1mm/s, post-test speed was 1mm/s, distance was 10mm and exposure time was 3 sec. The following parameters were determined using software (TMS-Pro): Hardness (N cm^{-2}) = maximum force required to compress the sample (H); Springiness (cm) = ability of sample to recover its original form after a deforming force was removed (S); Cohesiveness = extent to which sample could be deformed prior to rupture (A2/A1, A1 being the total energy required for first compression and A2 the total energy required for the second compression); Gumminess (N cm^{-2}) = force necessary to disintegrate a semisolid sample for swallowing (H×Cohesiveness); Chewiness (N cm^{-1}) = work to masticate the sample for swallowing (S×Gumminess).

Sensory evaluation

A Seven member experienced panel comprising of scientists and postgraduate students of the department evaluated the samples for the attributes viz. appearance and colour, flavour, texture, juiciness and overall acceptability using 8 point descriptive scale (Keeton, 1983), where 8=extremely desirable and 1=extremely undesirable. The panelists were seated in a room free of noise and odours and suitably illuminated with natural light. The potable water was provided in between samples to cleanse the mouth palate.

Table 3. Effects of different cooking methods on physico-chemical quality attributes of chicken meat cutlets.

Treatments	Deep fat frying	Oven cooking	Air frying	Oven + Shallow frying
		pH		
C	6.19±0.01^{AB}	6.18±0.02^{A}	6.18±0.03	6.19±0.01^{AB}
T1	6.21±0.02^{B}	6.24±0.02^{B}	6.24±0.02	6.24±0.02^{B}
T2	6.15±0.01^{Aa}	6.20±0.02^{Ab}	6.23±0.03^{b}	6.15±0.01^{Aa}
		Cooking yield (%)		
C	88.75±0.15^{Ab}	85.95±0.76^{Aa}	88.58±0.32^{Bb}	88.57±0.20^{Ab}
T1	90.89±0.26^{Bb}	89.03±0.36^{Ba}	88.85±0.18^{Ba}	89.74±0.27^{Aab}
T2	90.51±0.35^{Bb}	89.90±0.19^{Bb}	87.86±0.15^{Aa}	90.51±0.35^{Bb}
		Increase in height (%)		
C	52.98±0.92^{Aa}	53.28±1.38^{Ab}	51.56±0.92^{Aa}	52.16±0.88^{Aa}
T1	64.91±1.39^{B}	59.74±1.48^{B}	61.97±1.39^{B}	64.91±3.36^{B}
T2	67.72±4.08^{B}	63.85±0.72^{C}	67.72±4.08^{B}	66.55±4.68^{B}
		Decrease in length (%)		
C	9.97±0.7^{a}	13.20±1.17^{b}	10.24±0.60^{Aa}	10.03±0.68^{Ba}
T1	9.45±0.88^{ab}	10.99±0.33^{b}	8.40±0.26^{Aa}	9.27±0.89^{Bab}
T2	8.03±0.22^{a}	11.26±0.16^{b}	7.48±0.21^{Ba}	7.82±0.25^{Aa}
		Decrease in breadth (%)		
C	17.45±0.75^{Bb}	12.46±0.46^{Ba}	17.45±0.75^{Bb}	17.45±0.75^{Bb}
T1	11.12±1.52^{Ab}	6.32±0.39^{Aa}	11.13±1.52^{Ab}	11.13±1.52^{Ab}
T2	7.80±1.15^{A}	5.90±0.42^{A}	7.80±1.15^{A}	7.80±1.15^{A}
		Moisture (%)		
C	57.44±0.20^{Ab}	56.27±0.32^{Aa}	56.83±0.38^{Aa}	57.61±0.16^{Ab}
T1	58.97±0.21^{B}	58.14±0.36^{B}	58.19±0.31^{B}	58.67±0.25^{B}
T2	58.60±0.34^{Bb}	57.25±0.30A^{Ba}	58.36±0.34^{Bb}	59.02±0.49^{Bb}
		Fat (%)		
C	13.27±0.15^{B}	6.48±0.23^{A}	6.69±0.18^{A}	12.54±0.19^{B}
T1	15.52±0.21^{Cc}	7.19±0.27^{Ba}	7.81±0.07^{Cb}	13.17±0.12^{Cc}
T2	12.65±0.15^{Ac}	5.84±0.17^{Aa}	5.92±0.16^{Ba}	11.74±0.27^{Ab}

n=6; C= Control (without binder); T_1= CMC with 30% meat emulsion, T_2= CMC with 3% maida
*Mean±S.E. with different superscripts row-wise and column-wise differ significantly (P<0.05)

Table 4. Effects of different cooking methods on instrumental texture profile of chicken meat cutlets**.**

Treatments	Deep fat frying	Oven cooking	Air frying	Oven + Shallow frying
Hardness (N/cm^2)				
C	14.70±0.47^C	14.69±0.50^C	14.40±0.43^C	14.28±0.24^C
T_1	10.52±0.17^A	10.18±0.23^A	10.02±0.19^A	09.88±0.12^A
T_2	13.13±0.40^B	12.09±0.36^C	11.83±0.40^B	12.38±0.18^B
Springiness (mm)				
C	28.15±0.51^B	26.56±0.63^A	27.95±0.57^B	28.55±0.72^B
T_1	26.92±0.37^A	27.06±0.40^{AB}	26.52±0.37^A	27.52±0.37^A
T_2	27.44±0.23^{AB}	28.22±0.36^B	27.34±0.33^{AB}	27.89±0.28^{AB}
Stringiness				
C	21.62±1.35	19.49±0.51	22.09±1.26	22.02±1.05
T_1	23.53±1.58	22.22±1.29	23.06±1.73	23.13±1.08
T_2	24.58±1.30	21.45±1.24	23.58±1.20	24.34±1.00
Cohesiveness (ratio)				
C	0.65±0.03	0.58±0.01^A	0.60±0.08	0.52±0.05
T_1	0.75±0.04	0.77±0.03^B	0.73±0.05	0.70±0.06
T_2	0.76±0.04	0.82±0.04^B	0.78±0.02	0.72±0.02
Chewiness (N/cm)				
C	189.84±18.55	213.46±3.79^B	185.41±16.53	184.82±15.52
T_1	175.18±19.94	163.64±6.40^A	179.81±18.34	171.14±16.90
T_2	151.10±15.91	143.65±9.08^A	149.16±16.51	146.10±18.95
Gumminess (N/cm^2)				
C	7.75±0.39	8.23±0.04	8.05±0.29	7.58±0.28
T_1	7.13±0.96	6.74±0.94	7.03±0.56	6.96±0.45
T_2	6.13±0.62	6.39±0.58	6.03±0.44	5.88±0.32
Resilience				
C	0.72±0.03	0.73±0.01	0.71±0.04	0.68±0.06
T_1	0.75±0.03	0.67±0.09	0.69±0.07	0.72±0.02
T_2	0.77±0.01	0.80±0.02	0.78±0.01	0.74±0.08

n=6; C= Control (without binder); T_1=CMC with 30% meat emulsion, T_2= CMC with 3% maida

*Mean±S.E. with different superscripts row-wise and column-wise differ significantly (P<0.05)

Statistical analysis

The data obtained from various trials under each experiment were subjected to statistical analysis (Snedecor and Cochran, 1994) for Analysis of Variance (ANOVA) and Duncan's multiple range test (DMRT) to compare the means by using SPSS-16 (SPSS Inc., Chicago, IL,USA). Each experiment was replicated six times. The level of significant effects, least significant differences were calculated at appropriate level of significance was taken as 5% for a pair-wise comparison of treatment means.

RESULTS AND DISCUSSION

Physico-chemical quality

Physico-chemical quality of chicken meat cutlets indicated significant differences in different cooking methods (Table 3). The mean pH values of T1 was recorded significantly (P<0.05) higher than the T2 and C. This could be due to higher pH of emulsion incorporated in CMC, which contribute STTP in the formulation. There was no significant difference in pH of treatments as well as control samples under air frying.

Under deep fat frying and oven cooking, cooking yield of treatments were recorded significantly (P<0.05) higher than control. This could be due to better water retention and binding ability in the treatments. Under air frying, Cooking yield of T2 was significantly (P<0.05) lower than T1 and C. Amongst the different cooking methods, cooking yield of control under oven cooking was recorded significantly (P<0.05) lower than the other cooking methods. Cooking yield was comparable under air frying and oven cooking. For T2, cooking yield was recorded significantly lower in air frying as compared to other methods. Similar results were observed by Nisar *et al*. (2007) in buffalo meat patties.

The increase in height was recorded highest for T2 irrespective of cooking methods. However for control sample, the increase in height was measured significantly (P<0.05) higher under oven cooking as compared to the other cooking methods, whereas for other samples viz. T1 and T2, the increase in height was comparable for all cooking methods. Decrease in length were recorded comparable for all samples under deep fat frying and oven cooking, whereas for air frying and combination method of cooking showed significant decrease in length for Control samples as compared to treatments. Amongst different cooking methods, control showed significantly (P<0.05) higher percent decrease in length in oven cooking as compared to other cooking methods. Amongst samples, decrease in heights were recorded significantly (P<0.05) higher for control as compared to T1 and T2. The better dimensional properties of T1 and T2 over control might be due to better textural and binding properties of treatments due to presence of refined wheat flour and meat emulsion.

The moisture percent of treated samples were recorded significantly (P<0.05) higher than control under different cooking methods. This could be due to better water retention and water binding ability of treatments, due to presence of refined wheat flour and meat emulsion in T1 and T2, respectively. Similar findings have been reported by Verma *et al*. (2013). Under different cooking methods, moisture percent were recorded significantly (P<0.05) lower for oven cooking than other cooking methods.

The fat content was observed highest for T1 under deep fat frying and combination of oven cooking and shallow frying. This could be due to higher content in emulsion incorporated CMC and amount of fat absorption during frying. The fat percent was significantly (P<0.05) lower in air fried and oven cooked methods irrespective of type of product. This result is in agreement with the findings of Verma *et al*. (2012) and Chhetri *et al*. (2011).

Texture profile and colour analysis

There was no significant difference in the instrumental textural profile of chicken meat cutlets amongst different cooking methods, although control group showed higher textural value than that of T1 and T2 (Table 4). Amongst the treatments, hardness values were recorded significantly (P<0.05) higher for control and lowest for T1. The increase hardness of control might be due to less moisture retention under different cooking methods. There was no significant difference for stringiness, gumminess and resilience in between treatments as well as cooking methods. Cohesiveness and chewiness values showed significant difference under oven cooking. Cohesiveness and chewiness values of control was significantly (P<0.05) lower than T1 and T2. Similar results were also reported by Pawar *et al*. (2002) in chicken patties and Rababah *et al*. (2006) in biscuits.

Instrumental colour profile of treated as well as control samples were comparable under different cooking methods (Table 5). *L** value of all samples were comparable under oven cooking and air frying. Under deep fat frying and combination of oven cooking and shallow frying, control recorded significantly (P<0.05) higher value than T2 whereas T2 and T1 showed comparable values. This might be due to increase in lightness in binders (meat emulsion and refined wheat flour) incorporated CMC. The *a** values of all samples including treatments as well as control were comparable under different cooking methods and vice-versa. However, redness values were lower in air fried and oven cooked products than deep fat fried and combination cooking methods. The browning of the product was better in oil frying than air frying. These results were confirmed by the sensory panel as well. The *b** value of treatments as well as control were recorded comparable under different cooking methods. The *b** of T2 were recorded significantly (P<0.05) lower for oven cooking as compared to other methods of cooking.

Table 5: Effects of different cooking methods on instrumental colour profile of chicken meat cutlets**.**

Treatments	Deep fat frying	Oven cooking	Air frying	Oven + Shallow frying
		*L**		
C	44.23 ± 1.73^{B}	43.74 ± 1.78	39.80 ± 1.64	44.24 ± 1.73^{B}
T_1	40.68 ± 1.74^{AB}	38.80 ± 1.24	41.53 ± 1.45	40.69 ± 1.74^{AB}
T_2	38.96 ± 1.08^{A}	39.21 ± 1.90	39.91 ± 0.49	38.96 ± 1.08^{A}
		*a**		
C	14.53 ± 0.52^{c}	12.54 ± 0.31^{b}	10.34 ± 0.42^{a}	13.23 ± 0.58^{c}
T_1	13.76 ± 0.72^{b}	11.13 ± 1.47^{a}	10.66 ± 0.77^{a}	14.26 ± 0.32^{b}
T_2	14.04 ± 0.25^{c}	11.95 ± 0.37^{a}	10.92 ± 0.58^{a}	12.04 ± 0.85^{b}
		*b**		
C	27.83 ± 1.80	24.54 ± 1.81	26.43 ± 2.00	26.33 ± 0.65
T_1	23.97 ± 1.40	25.36 ± 1.96	24.90 ± 1.30	23.01 ± 1.10
T_2	24.99 ± 0.53^{b}	22.56 ± 0.86^{a}	25.00 ± 0.53^{b}	25.50 ± 0.51^{b}

n=6; C= Control (without binder); T_1= CMC with 30% meat emulsion, T_2= CMC with 3% maida

*Mean±S.E. with different superscripts row-wise and column-wise differ significantly (P<0.05)

Sensory qualities

Sensory scores for appearance, flavour, texture, juiciness, and overall acceptability of treated as well as control samples are presented in Table 6. Colour and appearance scores of control and treated samples did not differ significantly (P>0.05) amongst themselves with respect to different cooking methods however, cooking methods significantly (P<0.05) changes the appearance of chicken meat cutlets (CMC). Amongst treatments, T2 showed highest scores in comparison to T1 and C for deep fat frying and combination of oven and shallow frying. This might be due to appearance of golden colour upon frying.

Table 6. Effects of different cooking methods on sensory profile of chicken meat cutlets**.**

Treatments	Deep fat frying	Oven cooking	Air frying	Oven + Shallow frying
Colour and appearance				
C	6.42±0.15^{Ab}	6.44±0.15^{Aa}	6.10±0.13^{Aa}	6.25±0.11^{Ab}
T_1	6.67±0.17^{Ab}	6.92±0.18^{Bb}	6.17±0.17^{Aa}	7.02±0.15^{Ab}
T_2	7.42±0.15^{Bb}	7.33±0.17^{Bb}	7.12±0.15^{Ba}	7.18±0.15^{Ba}
Flavour				
C	6.25±0.16^{Aa}	6.42±0.15^{Aab}	6.67±0.11^{Ab}	6.33±0.11^{Aab}
T_1	6.50±0.20^{A}	6.68±0.30^{A}	6.75±0.17^{A}	6.58±0.10^{A}
T_2	7.33±0.11^{B}	7.25±0.11^{B}	7.18±0.16^{B}	7.50±0.18^{B}
Juiciness				
C	6.08±0.08^{A}	6.46±0.20^{A}	6.25±0.17^{A}	6.28±0.18^{A}
T_1	6.42±0.18^{A}	6.58±0.16^{A}	6.26±0.14^{A}	6.33±0.11^{A}
T_2	7.33±0.17^{B}	7.42±0.15^{B}	7.25±0.13^{B}	7.50±0.18^{B}
Texture				
C	6.33±0.17^{A}	6.16±0.17^{A}	6.42±0.20	6.17±0.17^{A}
T_1	6.67±0.11^{AB}	6.76±0.11^{B}	6.58±0.08	6.58±0.08^{A}
T_2	7.00±0.22^{Aab}	6.92±0.15^{Bab}	6.67±0.11^{a}	7.25±0.17^{Bb}
Overall acceptability				
C	6.42±0.15^{A}	6.25±0.11^{A}	6.08±0.08^{A}	6.58±0.27^{A}
T_1	6.75±0.28^{A}	6.67±0.11^{A}	6.72±0.21^{B}	6.78±0.14^{A}
T_2	7.51±0.13^{Bb}	7.33±0.21^{Bb}	6.58±0.27^{ABa}	7.75±0.1z^{Bb}

n=21; C= Control (without binder); T_1= CMC with 30% meat emulsion, T_2= CMC with 3% maida
*Mean±S.E. with different superscripts row-wise and column-wise differ significantly (P<0.05)

Under air frying colour and appearance value of C and T1 were comparable, however for oven cooking, colour and appearance of C and T1 was comparable. The appearance and colour scores were significantly lower in air frying cooking method than other cooking method. The comparable appearance scores in all the products can be attributed to similar method of enrobing adopted for all the products.

Amongst treatments, flavour scores were significantly (P<0.05) improved for T1, whereas T2 and C were comparable under different cooking methods. This could be due to presence of meat emulsion in T1. Under different cooking methods, flavour scores of T1 and T2 were comparable. Deep fat frying significantly reduced the flavour score of control as compared to air frying, whereas upon oven cooking and combination of oven and shallow frying, the flavour scores were comparable. It might be due to retention of meat flavour in air frying method. Cremer and Chipley (1977) and Nath *et al*. (1996) had also demonstrated similar results. Under different cooking methods, Juiciness values of all treatments were comparable. Amongst treatments, T2 showed significantly (P<0.05) higher value than T1 and C under all cooking methods. This could be due to better water retention by T2 due to presence of meat emulsion. Texture values of T2 were recorded significantly (P<0.05) higher amongst treatments under all cooking methods except air frying. Under different cooking methods, texture of C and T1 were comparable, whereas it was highest for oven and shallow frying combination for T2.

Overall acceptability did not differ significantly under different cooking methods for C and T1, whereas it was recorded significantly higher for T2 under combination of oven and shallow frying combination. Overall acceptability for T2 was recorded lowest for air frying. Amongst treatments overall acceptability of C and T1 were comparable under various cooking methods. T2 showed significantly (P<0.05) higher overall acceptability score as compared to C and T1.

Thus on the basis of cooking yield, fat and moisture retention, and sensory attributes, the combination of oven and shallow frying cooking was found suitable.

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