Optimization of Formulation and Processing Technology of Chicken Meat Spread

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ABSTRACT

The present work was designed to optimize the formulation and processing technology for development of chicken meat spread. Several preliminary trails were carried out to standardize the formulation of chicken meat spread. Next experiment was done to optimize the processing technology of chicken meat spread in terms of three different cooking methods *viz.* braising, microwave and steam cooking without pressure for different time periods. Three treatments, each selected from one cooking method were compared on the basis of various physico-chemical and sensory attributes to have one best cooking method. pH, cooking yield and moisture content of steam cooking without pressure (S) were significantly ($P<0.05$) higher than braising (B) and microwave (M) cooking. M and B had significantly ($P<0.05$) higher fat and ash contents respectively. There was no significant difference in protein content and yellowness value, however redness and lightness values showed significant ($P<0.05$) difference among the treatments. Among the sensory attributes, spreadability scores were significantly ($P<0.05$) higher in S, however flavor, meat flavor intensity and overall acceptability scores of B were significantly ($P<0.05$) higher than S and M. Therefore, it might be concluded that well accepted chicken meat spread might be prepared by braising cooking method for 15 minutes.

Keywords: *Chicken spread, Braising, Microwave, Steam cooking without pressure, Physico-chemical properties, Sensory attributes*

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INTRODUCTION

Food convenience is fundamental to present-day food markets. Underlying drivers for convenience have been identified as alterations in lifestyles, including the assimilation of women in the workforce, the emergence of single-person and small households, variable family eating times, role overload, consumer deskilling in terms of knowledge and cooking skills, as well as individualistic and impulsive consumerism focusing on value-for-money, stress reduction and time saving (Bernues *et al.,* 2012). Present consumer demands for reduced physical and mental investment in the general process of shopping, preparation, cooking, and handling of the food, as well as in the clearing up after the meal (Buckley *et al.,* 2007). Some foods are even expected to be eaten effortlessly during everyday activities, *i.e.* while watching television, working at a desk, phoning, or on the move.

Spreadable products are a kind of convenience snack meant to be spread on or sandwiched in a base like bread. Spreads are added to food in order to enhance the flavor and/or texture of the food, which may be considered bland without it. Many spreadable products like cheese spread, mayonnaise, jam, jelly are available in Indian convenient snack market, however spreadable meat product is not very common yet among Indian consumers. Now a day's consumers are much more health conscious and convenience is coupled to many divergent issues as pricing, availability, choice, sustainability, palatability, safety and health. The global meat snacks market is growing because of various factors such as demand for low calorie and high protein content food products and growing health and fitness awareness among consumers (Troy and Kerry, 2010). Chicken meat is capable of fulfilling the majority of these requirements. Thus, the spreadable meat product may add a new dimension to convenience food and poultry meat may be a better option for the preparation of spread. Poultry meat has become a mass consumer product due to its cost competitiveness, nutritional quality, universal availability and absence of religious taboos. Poultry sector in India plays an important role in livestock economy with an average annual growth rate of about 5% in layer and 10% in broiler sectors over the last decade (Padhi *et al.,* 2016). As per DAHD (2019), total meat production in India was 8.11 million tons in 2018-

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19, with contribution of buffalo, goat, sheep, pig, cattle and poultry as nearly 19%, 14%, 8%, 5%, 4% and 50.06% respectively. The country contributes a major share in poultry production in the world having 5th rank with production estimated at 4.06 million tons of broiler meat (DAHD, 2019). Availability of high biological value animal protein, essential amino acids, fat, essential fatty acids, vitamins and other nutrients also ensure its popularity among masses.

Meat spread is value added convenient product containing various ingredients like meat, fat, spices and other food additives. The product is cooked to make it palatable, digestible and microbiologically safe. Meat products undergo many changes during cooking, both physical and chemical, including weight loss, modifications of water holding capacity, texture, muscle fiber shrinkage, color and aroma development that are strongly dependent on protein denaturation and water loss. Quality characteristics of cooked meat products are also dependent on composition and characteristics of muscle and cooking methods as well as time/temperature evolution during cooking. The heating profile affects the sequence and extent of meat protein denaturation in the cooking process and, consequently, the physical and sensory properties of the final product (Riva and Schiraldi, 1994). In particular the application of slow cooking rate has been reported to have desirable effects in terms of higher cooking yield and tenderness (Lawrence *et al.*, 2001). Microwave cooking utilizes high-frequency electromagnetic waves which causes oscillation of water molecules, friction, and resultant heat generation. Microwave cooking does not affect the nutrient content of foods to a larger extent than conventional heating with greater retention of many micronutrients, probably due to the reduced preparation time (Lassen *et al.,* 2002). Steam cooking utilizes higher cooking temperature with minimized time required for gelatinization of collagen, but it causes loosening of texture and more nutrients loss than other cooking methods. However, braising is a combination of dry and moist heat to cook less tender meat cuts where meat may be browned over high heat before adding water and at the later phase of cooking, the pan is covered for moist heat retention. In this method of cooking, flavor is developed under dry heat while moist heat is applied for tenderization of tough meat cuts. Therefore, the present research work was designed to address the issues related with effect of different cooking methods on physico-chemical and sensory qualities of chicken spread.

MATERIALS AND METHODS

The experiments were conducted in the Department of Livestock Products Technology, College of Veterinary Science and Animal Husbandry, DUVASU, Mathura. Dressed chicken carcasses were procured from authorized meat shops at Mathura and were brought to the Department of Livestock Products Technology, College of Veterinary Science and Animal Husbandry, DUVASU, Mathura. Thereafter, the hot carcasses were kept in refrigerator at 4 ± 1^0C for 4-6 hours and then manual deboning was performed. The meat was kept under frozen condition at -18^0C in deep freezer till further use. Spice mix of Agmark standards (Catch Meat Masala®), the food grade standard (Iodized salt (Tata®), refined oil (Fortune®), skimmed milk powder (Everyday®), honey (Dabar®) and condiments (onion, ginger and garlic) used for study were procured from local market. All the plasticizers (glycerol, sorbitol, pectin), corn starch and other chemicals were procured from Hi Media laboratories (P) Ltd., Mumbai. Thermo rigid air tight PET containers were sourced from local market for packaging and were pre-sterilized by exposing to ultraviolet light for 30 minutes before use.

***Experimental design*:** Several preliminary trails were carried out to standardize the formulation and method of preparation of chicken meat spread based on literature available. Next experiment was done to optimize the processing technology of chicken meat spread in terms of three different cooking methods with different time periods *viz.* braising for 10, 15 and 20 minutes, microwave cooking at 540 MHz for 3, 5 and 7 minutes and steam cooking for 25, 30 and 35 minutes; respectively. Three treatments, each selected from one cooking method were compared on the basis of various physico-chemical properties and sensory attributes to have one best cooking method.

***Processing of chicken spread*:** Chicken meat spread was prepared as per method given by Kumar *et al.* (2015) with slight modifications and given in flow diagram No. 1. Frozen deboned meat was thawed at refrigeration temperature overnight. Thawed lean meat was cut into smaller chunks of 1-2cm. All the ingredients *i.e.* common salt, vegetable oil, ice flakes, skimmed milk powder, corn starch, condiments and spice mix were weighed accurately as per the formulation. The formulation of chicken meat spread has been given in table.1. All the ingredients were properly mixed with chicken chunks and massaged for 2-3 minutes to have desired consistency of batter. The batter was then cooked with appropriate cooking method for optimum time. After cooking,

pre weighed honey was added and finally ground in pre sterilized food grinder (Inalsa Mixie) to have chicken spread. The chicken meat spread was packed in pre sterilized air tight PET container at refrigeration temperature for further analysis.

Frozen deboned meat
↓
Overnight thawing at refrigeration temperature
↓
Cutting of meat into small chunks (1-2cm)
↓
Weighing of salt, spices, condiments, skimmed milk powder, corn starch, vegetable oil, ice flakes and other additives
↓
Addition of all ingredients with meat chunks and proper mixing
↓
Massaging of batter for 2-3 minutes
↓
Cooking of batter for optimum time
↓
Addition of honey
↓
Grinding for 3-4 min to get fine paste like consistency
↓
Packaging in air tight PET container
↓
Storage at refrigeration temperature at 4 ± 2^0C

Fig. 1 Preparation of Chicken Meat Spread

Table 1: Formulation used for preparation of chicken meat spread

Ingredients	Percent (%)
Chicken meat	50.0
Vegetable oil	6.0
Salt	1.5
Spice mix	2.0
Condiments	3.0
Skimmed milk powder	1.0
Corn starch	2.5
Honey	2.0
Water	32.0

***Analytical procedures*:** pH was determined by using digital pH meter (WTW, Germany, model pH 330i) by immersing the spear type combination electrode (Sentix®, Germany) directly into minced meat sample following the procedure of Trout *et al*. (1992). The moisture, protein, fat and ash content of chicken meat spread were determined following standard methods as per AOAC (1995). The cooking yield was calculated as under and expressed as percentage (Murphy *et al.*, 1975). The color parameters of chicken meat spread were measured using colorimeter of Color Tech PCM+ (Color Tec Associates Inc. Clinton NJ, USA). The color reading includes lightness (L^*), redness (a^*) and yellowness (b^*).

Sensory evaluation: The sensory quality of samples was evaluated by using 8 point hedonic scale (Keeton *et al.*, 1983) where 1=extremely disliked and 8= extremely liked. A sensory panel (semi trained) of seven judges drawn from post-graduate students and faculty of Veterinary College, DUVASU, Mathura were requested to evaluate the product for different quality attributes *viz*., color and appearance, flavor, texture, juiciness, saltiness, spreadability, mouth coating, meat flavor intensity and overall acceptability in sensory room of department.

Statistical analysis: The data obtained in the study on various parameters were statistically analyzed on 'SPSS-16.0' software package as per standard methods of Snedecor and Cochran (1995). A total of three replications were carried out with each analysis done in duplicate (n=6), except sensory studies where seven sensory panelists did sensory evaluation three times and n= 21observations were recorded for each sensory attribute. Data were subjected to one way analysis of variance and Duncan's Multiple Range Test (DMRT) for comparing the means to find the effects between samples at 5% level.

RESULTS AND DISCUSSIONS

Optimization of formulation and processing technology: Several preliminary trails were carried out to standardize the formulation and method of preparation of chicken meat spread on the basis of literature available. Three different cooking methods with different time periods *viz.* braising for 10, 15 and 20 minutes, microwave cooking at 540 MHz for 3, 5 and 7 minutes and steam cooking for 25, 30 and 35 minutes; respectively were used under three different sub experiments to optimize the processing technology. Three treatments (one from each cooking method) *i.e.* braising for 15 minutes (B), microwave cooking at 540 MHz for 15 minutes

(M) and steam cooking without pressure (S) were selected on the basis of sensory evaluation and further compared to select the best cooking method.

Comparison of different cooking methods for preparation of chicken spread

Physico-chemical analysis: The results of the effect of different cooking methods viz. braising (B), microwave cooking (M) and steam cooking without pressure (S) on proximate analysis of chicken meat spread are represented in Table 2. The pH, cooking yield and moisture content of S were significantly (P<0.05) higher than B and M. The higher cooking yield of S might be due to incorporation of moisture in product during steam cooking. Nisar *et al.* (2010) also observed significantly (P<0.05) higher moisture content in buffalo patties prepared by steam cooking than microwave and hot air cooking. There was no significant difference among the treatments for protein content. Fat content of M was significantly (P<0.05) higher than B and S, however there was no significant difference between S and B. Parang *et al.* (2011) also observed significantly (P<0.05) higher fat content in *L. dorsi* muscle of camel cooked by microwave cooking than braising and roasting. Nisar *et al.* (2010) also reported higher fat content in buffalo patties prepared by microwave cooking than braising and pressure cooking. The ash content of B was significantly (P<0.05) higher than M followed by S, which could be corelated to the findings of moisture content and other proximate parameters in present study.

Table 2: Effect of cooking methods on physico-chemical properties (Mean±SE) of chicken spread

Parameters	B	M	S	Treatment Mean
pH	6.08±0.01^{c}	6.11±0.05^{b}	6.18±0.01^{a}	6.12±0.02
Cooking yield (%)	71.38±0.57^{c}	77.73±0.62^{b}	86.00±0.52^{a}	77.13±0.52
Moisture (%)	61.28±0.30^{c}	66.33±0.30^{b}	69.68±0.53^{a}	65.76±0.34
Protein (%)	18.14±0.24	17.47±0.23	17.23±0.69	17.61±0.25
Fat (%)	7.14±0.16^{b}	8.27±0.42^{a}	7.20±0.28^{b}	7.53±0.21
Ash (%)	3.16±0.04^{a}	2.83±0.05^{b}	2.08±0.22^{c}	2.69±0.11

Overall means bearing different superscripts in a row (a, b, c, d…) differ significantly (P<0.05)

***Color estimation*:** The effects of various cooking methods on color values of chicken meat spread are presented in Table 3. The lightness *(L*)* values of M and S were significantly (P<0.05) higher than B. The redness *(a*)* value of B was significantly (P<0.05) higher than M and S, however there was no significant difference between M and S. The higher redness value of B might be due to non enzymatic browning and frying before moist heating of spread in braising. There was no significant difference for yellowness *(b*)* value among the treatments. Parang *et al.* (2011) also observed no significant (P>0.05) difference in *b* value of *L. dorsii* muscle of veal meat cooked by various cooking methods. Goswami *et al.* (2015) also reported significantly (P<0.05) higher hue angle and chroma values in carabeef cookies baked at higher temperature 170-180^{0}C than cookies baked at 150-160^{0}C.

***Sensory quality*:** The effects of various cooking methods on sensory scores of chicken meat spread are presented in Table 4. There was no difference in color and appearance, texture, juiciness, saltiness and mouth coating scores among the treatments. Flavor scores of B were significantly (P<0.05) higher than M, however S scores were comparable to B and M. The higher flavor scores of B might be due to maillard reaction resulting into pleasant flavor and aroma to the product. Raj *et al.* (2005) also reported higher flavor scores of braising than microwave cooking in meat emulsion. The spreadability scores of S were significantly (P<0.05) higher than B and M, however there was no significant difference between M and B. Meat flavor intensity scores of B and M were significantly (P<0.05) higher than S. The changes that took place in the fried food might be due to the induction of water loss, the stimulation of thermo-oxidation reactions, the change of the color to brown, and modification of the fatty acid profile (depending on the type of fat and oil used) (Ramirez *et al.*, 2004). Singh et al. (2019) also observed changes in colour, texture and flavor scores due to pre-cooking of marinated chicken meat during preparation of shelf stable chicken pickle. Overall acceptability scores of B were significantly (P<0.05) higher than M followed by S. Pandey (2006) also reported that braising was the most acceptable cooking method during the preparation of the meat spread from the pork.

Table 3: Effect of cooking methods on color values (Mean±SE) of chicken spread

Parameters	B	M	S	Treatment Mean
Lightness (*L**)	43.23±0.29[b]	48.01±0.45[a]	47.41±0.20[a]	46.21±0.27
Redness (*a**)	8.04±0.50[a]	6.52±0.34[b]	6.23±0.20[b]	6.93±0.27
Yellowness (*b**)	15.29±0.29	15.88±0.18	15.71±0.28	15.63±0.15

Overall means bearing different superscripts in a row (a, b, c, d…) differ significantly (P<0.05)

CONCLUSION

Various cooking methods for different time combination had significant effect on quality characteristics of chicken spread. pH, cooking yield and moisture content of S were significantly (P<0.05) higher than B and M. M and B had significantly (P<0.05) higher fat and ash contents respectively. There was no significant difference in protein content and yellowness value, however redness and lightness showed significant (P<0.05) difference among the treatments. Among the sensory attributes, chicken meat spread cooked with braising had higher flavor, meat flavor intensity and overall acceptability than that of other cooking methods. It can be concluded that well accepted chicken meat spread can be prepared by braising for 15 minutes in terms of physcio-chemical properties and sensory evaluation.

Table 4: Effect of cooking methods on sensory attributes (Mean±SE) of chicken spread

Parameters	B	M	S	Treatment Mean
Color and appearance	7.14±0.05	7.00±0.07	7.02±0.11	7.05±0.04
Flavor	7.11±0.05[a]	6.90±0.06[b]	7.00±0.06[ab]	7.00±0.03
Texture	7.00±0.05	6.92±0.06	7.02±0.06	6.98±0.03
Juiciness	7.07±0.07	6.95±0.10	7.04±0.07	7.02±0.05
Saltiness	7.14±0.07	7.19±0.07	7.14±0.05	7.15±0.03
Mouth coating	7.16±0.05	7.11±0.07	7.10±0.04	7.13±0.03
Spreadability	5.71±0.08[b]	5.59±0.08[b]	6.09±0.03[a]	5.80±0.04
Meat flavor intensity	7.14±0.05[a]	7.18±0.05[a]	7.04±0.05[b]	7.12±0.03
Overall acceptability	7.42±0.06[a]	7.14±0.07[b]	7.02±0.08[c]	7.13±0.04

Overall means bearing different superscripts in a row (a, b, c, d…) differ significantly (P<0.05)

COMPETING INTERESTS

The authors have no competing interests either technical, financial or personal between themselves or others that might bias the work

ETHICAL STATEMENT: Not applicable

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