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Effect of Frying on Quality Characteristics of Chicken Meat *Samosas*

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ABSTRACT

Present study was undertaken to assess the effect of deep fat frying on quality characteristics of chicken meat *samosas*. The formulation and processing conditions for preparation of chicken meat *samosas* were standardized. A total of three types of *samosa* were prepared by using various frying methods as deep fat frying (T1, 185ºC for 6 min), flash frying (T2, 185ºC for 2 min) and flash frying followed by deep fat frying (T3, 185ºC for 5 min). The developed products along with raw *samosas* (C) were studied for various physico-chemical, proximate parameters, instrumental colour profile and sensory analysis. T1 and T3 products were compared for sensory attributes. The pH of T3 samples was noted significantly ($P<0.05$) lower than T1, T2 and raw *samosa*. T3 *samosa* was recorded with highest fat percentage and calorific value. Protein content of T1 and T2 were comparable and was significantly ($P<0.05$) higher than T3. The T1 samples were noted with significant ($P<0.05$) higher flavour and overall acceptability attributes as compared to T3 samples. Thus, it can be concluded that *samosa* cooked by frying in refined soybean oil at 185ºC for 6 minutes had better sensory attributes with good nutritive value.

Keywords: Meat *samosa*, frying, quality attributes.

Rapid industrialization and urbanization has caused several changes in socio-cultural conditions of human beings such as less time to prepare food, working women, nuclear families and more dispensable income leading to change in food habits and lifestyles. In such scenario, there is rapid outburst in demands for ready-to-prepare/ ready-to-eat (RTP/RTE) snack food products. These products are small in size, convenient to store and transport, available in wide varieties of flavours, aroma and taste specifically suitable to a particular sections/ groups, have extended storage life at ambient temperature, etc. These snacks products are generally eaten in between regular meals for satisfying short-term hunger as well as supplying nutrients, energy but at present these are consumed throughout the day, even with regular meals. Thus in the present context, the overall nutritive value of snack products makes them indispensable items in human food basket (Singh *et al*., 2014 a,b; Singh *et al*., 2015 a,b; Kumar *et al*., 2019) by supplying considerable amount of nutrients and energy.

Samosa is a very popular enrobed snack product of Indian subcontinent and South East Asia. *Samosas* stuff/ mixture is prepared by frying mashed potato along with condiments, green coriander, black pepper, clove, spices, seasonings, green peas, salt, paneer, noodles, pasta and even meat in non-vegetarian *samosa*. This *samosa* mixture or stuff is wrapped in *samosas* sheet or casings and cooked by deep fat frying, air frying or oven baking. Different binders or extenders such as gram flours, texturized soy protein, etc., are usually added into *samosas* stuff to increase its binding, juiciness and sensory attributes. Sharma *et al*. (1988) incorporated 10% potato and 5% green peas in chevon *samosas* and observed significant improvement in binding and sensory attributes of *samosas* stuff.

Most of these snack products are energy dense, rich in saturated fat, have high carbohydrate content and very low in protein content, thus not preferred by health conscious consumers (Kumar *et al*., 2016). The nutritive quality of *samosa* depends upon the quality and quantity of ingredients used for its preparation. Vegetable protein lacks some essential amino acids such as tryptophan, threonine, lysine and addition of meat during preparation of *samosa* could improve the nutritive quality (by supplying high quality animal protein rich in all essential amino acids) as well as organoleptic attributes (such as appearance and colour, flavour, taste and acceptability). Chauhan *et al*. (2003) explored utilization of raw and cooked meat obtained from chicken carcass frames during preparation of *samosas* stuff and reported significant improvement of nutritive and sensory attributes of meat *samosas*. Anjaneyulu *et al*. (2008) also observed the strong marketing potential of meat *samosas* especially in urban areas of India.

In India, *samosas* are commonly fried in vegetable oils preferably in soybean oil, peanut oil and sunflower oil, having smoke point of 410-450ºF. Fat frying, being one of the oldest food preparation methods, causes several physico-chemical changes in food products such as protein denaturation, crust formation, browning reaction, starch gelatinization, drying out of surface, etc. These changes lead to several physical and chemical alterations in meat *samosas* at macro and micro levels (Oke *et al*., 2017). It is a common practice followed by some *samosas* manufacturers to store freshly prepared *samosas* by flash frying with aim to increase storage life, texture and facilitating easy serving. These semi-cooked or flash fried *samosas* are fried again at the time of sale or consumption. This double frying could result in high fat content in these *samosas*, and if reused oil is utilized in frying process, it could potentially harmful to human health by increasing content of fried fats in *samosas* which contains higher trans fat, HNE (4-hydroxy-2-trans-nonenal), free radicals and aldehyde content (FSSAI, 2009). There is a need to aware these *samosas* manufacturer to adopt right frying technology with the support of scientific data/ studies.

Thus present study was undertaken to assess the effect of frying on quality characteristics of chicken meat *samosas*.

MATERIALS AND METHODS

Source of raw materials

The White Leghorn spent hens (>72 weeks) were procured from Directorate of Livestock Farm, Guru Angad Dev Veterinary and Animal Sciences University (GADVASU), Ludhiana and were scientifically slaughtered in the experimental slaughterhouse of Department of Livestock Products Technology as per standard procedure. The carcasses were hot deboned and deboned meat was chilled overnight in refrigerator, packed in LDPE bags and stored under frozen condition (-18ºC) till further use. All other ingredients such as refined vegetable oil, hydrogenated vegetable oil, potato, spice ingredients, etc. used in the study were purchased from local market.

Formulation and processing of meat *samosa*

Several preliminary trials were conducted to standardize the formulation of chicken meat *samosa* mixture (used as filler material) and *samosa* dough for preparation of casing/ sheet of *samosa* used for wrapping *samosa* mix.

The frozen deboned chicken meat was withdrawn from deep freezer as per requirement and thawed overnight in a refrigerator (4±1ºC). The thawed chicken meat was cut into small pieces and minced through 6 mm plate in meat mincer (Mado Eskimo Mew-714, Mado, Germany). The boiled potato were smashed and mixed with minced meat. Other ingredients were also added into the mixture and mixed thoroughly (Table 1). This mixture was fried on pre-heated prestige frying pan on prestige induction heater (Prestige group Ltd., Bangalore), in refined soybean oil with continuous stirring till appearance of golden brown color. The mixture was tempered at room temperature and used as filler material for *samosas*.

Table 1: Formulation of *samosa* mixture

Name of ingredients	Percentage (w/w)
Minced meat	50.0
Potato	35.0
Green pea	6.0
Onion paste	3.0
Red chillies	1.5
Salt	1.5
Green coriander	1.5
Spice mix	1.5

For the preparation of *samosa* sheet, *samosa* dough was prepared by adding hydrogenated vegetable oil (3.0%), lukewarm water (2.0%) and carom seeds (1.0%) in refined wheat flour (94.0%). The mixture was kneaded for 10 min at room temperature and the dough was kept for 20 min after wrapping a wet cloth to keep it moist.

Preparation of chicken meat *samosa*

Samosa dough was sheeted and made into semicircular cuts. About 80 g of *samosa* mixture was filled into each sheet (approximately 10g) and it was given triangular shape. These raw *samosas* were deep fat fried in refined soybean oil at 185ºC for three different time till golden brown colour appears such as 6 min (T1), 2 min (T2, flash deep fried) followed by 5 min (T3).

Analytical procedures

pH

The pH of samples was determined with pH meter (FE-20-1-KIT, Mettler-Toledo India Pvt. Ltd., Mumbai). Ten gram sample was homogenized with 50 ml of distilled water for 1 minute using pestle and mortar. The equipment was calibrated by using standard solutions of pH 4.0, 7.0 and 9.0.

Instrumental Color profile

Instrumental color profile of meat *samosa* was measured by using Chroma Meter (CR-400 Konica Minolta, Japan) set at 2º of cool white light (D_{65}). The instrument was directly put on the surface of meat *samosa* and L^* (brightness 100, lightness 0), a^* (+ redness/- greenness) and b^* (+ yellowness/-blueness) values were recorded. The instrument was calibrated by using calibration kit provided with the instrument. Hue and Chroma were obtained by following formulas—

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

$$\text{Chroma} = (a^{*2} + b^{*2})^{1/2}$$

Proximate composition

The moisture, fat, protein and ash content of chicken meat *samosa* was estimated using automatic moisture analyzer, Socs Plus, Kel plus and Muffle furnace, respectively following the method of AOAC (2000). Energy values of samples were calculated on the basis of 100g using Atwater values for fat (9 Kcal/g), protein (4.02 Kcal/g) and carbohydrate (4 Kcal/g). Carbohydrate content was determined by subtracting method (carbohydrate = 100 – moisture + protien + fat + ash)

Sensory evaluation

A 12 members experienced sensory panel comprising scientists and postgraduate students of the Department analyzed chicken meat *samosas* for various sensory parameters viz. appearance and colour, flavor, texture, meat flavor intensity and overall acceptability on 8-point descriptive scale (Keeton 1983), where 8=most liked and 1=most unliked. Test samples were presented to the panelists after assigning suitable codes. The potable water was served for rinsing mouth between samples. Three sittings (n=36) were conducted for each replicate. The samples were numerically coded and presented to panelists in random order.

Statistical analysis

Data generated during present study was analyzed statistically on 'SPSS-16.0' (SPSS Inc., Chicago, II USA) software package as per standard methods (Snedecor and Cochran, 1994). Duplicate samples were drawn for each parameter and the whole set of experiment was repeated three times to have total 6 observations. Sensory evaluation was performed by a panel of twelve member judges. The mean values were reported along with standard error. For comparing sensory attributes of T1 and T3 products, t-test was performed. The statistical significance was estimated at 5% level ($p<0.05$) and evaluated with Duncan's Multiple Range Test (DMRT).

RESULTS AND DISCUSSION

Physico-chemical and proximate parameters

Frying had profound effect on physico-chemical and proximate parameters of chicken meat *samosa* (Table 2). The pH of *samosa* noted significant decreasing trend upon frying as raw *samosa* (C) exhibited highest pH value (5.93±0.03) and the double fried *samosa* (T3) had the lowest pH value (5.05±0.04). Singh *et al*. (2015) also reported lower pH value of deep fat fried chicken meat cutlets as compared to pH of oven cooked and air fried chicken meat cutlets. The pH of *samosa* mix was noted lower than *samosa* dough. Samosa dough mainly contained refined wheat flour, having pH of 6.25 and upon storing/ maturation of dough by wrapping in moist muslin cloth, a decreasing trend was noticed. This decreased pH of *samosa* dough upon storage could be due to fermentation, mainly by yeast. The pH of flour is an indicator of its ingredients, quality and possibility of contamination.

Deep fat frying resulted in significantly ($P<0.05$) decreasing moisture content as well as significantly ($P<0.05$) increasing fat content of *samosas*. This moisture loss and fat or oil uptake/ absorption of deep fat fried *samosas* were depend upon temperature of oil and frying duration, in general larger the frying duration leading higher moisture loss and fat absorption. Moisture content of raw samosa was recorded highest and it decreased significantly ($P<0.05$) upon deep fat frying. T1 *samosa* had significantly ($P<0.05$) lower moisture content than T2, which in-turn had significantly ($P<0.05$) higher moisture than T3. This could be due to longer frying duration for T3 than T1 and T2. During fat frying of *samosa*, transfer of heat takes place from oil to *samosa* casing through convection and from *samosa* casing to *samosa* mix by conduction. This heating caused removal of moisture from *samosa* and subsequently increasing temperature of *samosa*, leading to crust formation. The removal of moisture is accompanied by oil absorption; however overpressure during frying prevents oil absorption in large quantity (Mellema, 2003; Oke *et al*., 2018).

The removal of moisture and oil absorption is simultaneous process and most oil absorption by *samosas* could be due to vacuum created by condensation of water vapour (Gamble and Rice, 1988). The removal of moisture and rise in temperature leads to crust formation and in T1 *samosa*, this could inhibit further oil absorption, resulting in less fat content than T3. The fat content of T3 *samosa* was recorded highest followed by T2 and T1. Ufheil and Escher (1996) concluded based on their research on frying of potato slices with dyed oil, that product did not absorb fat during frying and it took oil through adhesion to the surface after frying. Moreira *et al*. (1997) also observed that 20% oil was absorbed by tortilla chips during frying and 80% of remaining oil was remain on surface, which later absorbed during cooling process (64%). Although fat absorption during frying is surface phenomenon but it depends upon several factors such as frying duration, oil temperature, composition of food, thermal conductivity, initial moisture content of product, product shape and texture, interfacial tension, and surface conditions of product (Pinthus and Saguy, 1994; Bouchon *et al*., 2003). The oil absorption during frying was directly related with moisture loss and this moisture loss was known to directly proportional to the square root of frying time. Further there has been a direct relationship between frying oil temperature and oil absorption (Kassama and Ngadi, 2004). Frying for long duration leads to accumulation of undesirable substances of food particles and thermal/ oxidative compounds of oil. These compounds cause increased oil viscosity, lower surface tension between oil and food and facilitates oil absorption (Debarganes *et al*., 2000; Jorge *et al*., 2005).

Protein content of T1 and T2 *samosas* was comparable and significantly ($P<0.05$) higher than T3 *samosa*. This could be due to loss of moisture and higher nutrient density/ concentration of cooked *samosa* (Bordin *et al*., 2013). The high protein content of chicken meat *samosa* might be due to incorporation of minced chicken meat and formation of some new products similar to protein during deep fat frying of *samosas*. These products might influenced the determination of protein content as measured by the Kjeldahl method. Similar findings have been reported by Ismail and Akram (2004) in fried fish. Ash content of T3 and T2 was recorded comparable and significantly ($P<0.05$) higher than T1 and control. This could be due to concentration effect during frying due to dehydration. During frying there was reports indicating loss of small quantity of minerals in oil during frying (Asghari *et al*., 2013; Czech and Stachyra, 2013), but this loss is very less compared to degree of concentration due to dehydration during frying.

Deep fat fried *samosa* showed higher energy value as compared to raw products. This could be due to higher oil and protein content of fried chicken meat *samosa*. The energy value of T3 was recorded highest due to higher fat and protein content. In the present study, there was approximately 40% increase in energy value of chicken meat *samosa* upon deep fat frying. USDA (2013) also stipulated 42-53% increase in energy value due to deep fat frying. The carbohydrate content of T3 was recorded

Table 2: Effect of frying on Physico-chemical and proximate parameters of chicken meat *samosa* (Mean±S.E.)*

Parameters	C	T1	T2	T3
pH	5.93±0.03^{d}	5.57±0.04^{c}	5.34±0.07^{b}	5.05±0.04^{a}
Fat (%)	4.43±0.08^{a}	10.98±0.08^{b}	12.57±0.14^{c}	13.11±0.12^{d}
Protein (%)	10.86±0.11^{a}	20.59±0.13^{c}	20.28±0.18^{c}	19.11±0.11^{b}
Ash (%)	0.358±0.009^{a}	0.437±0.008^{b}	0.500±0.009^{c}	0.521±0.008^{c}
Moisture (%)	32.29±0.67^{d}	12.68±0.15^{b}	14.30±0.17^{c}	11.60±0.16^{a}
Carbohydrate (%)	52.73±0.69^{a}	54.50±0.71^{ab}	52.82±0.63^{a}	55.22±0.49^{b}
Energy value (Kcal/100g)	294.39±2.61^{a}	399.59±3.42^{b}	405.95±2.73^{b}	415.73±2.50^{c}

*Means with different superscripts differ significantly (P<0.05) in a row; n = 6 for each treatment, C= control, raw chicken meat *samosa*, T1, T2 and T3 are *samosa* deep fat fried at 185 ºC for 6 min, 2 min and 2+5 min, respectively.

highest and significantly (P<0.05) higher than control and T2. The carbohydrate content of T1 was comparable to all other samples.

Instrumental colour profile

Deep fat frying had significant effect on colour attributes of chicken meat *samosa* (Fig. 1). Raw *samosa* exhibited highest *L** value and it showed a significant (P<0.05) decreasing trend with increasing frying duration. T3 samples were recorded significantly (P<0.05) lower brightness as compared to T1 which in turn had significant lower brightness than T2. The redness (*a**) value increased upon frying and T3 samples had highest redness score followed by T1, T2 and C. The significantly (P<0.05) lower redness value of T2 as compared to other fried samples could be due to short duration of frying in oil. The *b** value (yellowness) of T1 and T3 samples were comparable and were significantly (P<0.05) higher than T2 samples. There was marginal increase in *b** value upon flash frying. This change in colour attributes of *samosa* upon frying could be due to development of golden brown colour upon frying as a result of Maillard reaction and caramelization (Zamora and Hidalgo 2005; Velasco *et al*., 2008). Navasa (2005) noted faster browning upon frying at temperature above 150ºC as in the present experiment, chicken meat *samosa* were deep fat fried at 180ºC, resulting in optimum browning of *samosa* sheet/ casing. A frying temperature below 190ºC is recommended to prevent aldehydes formation in oil. Kumar *et al*. (2016) also observed browning of chicken meat biscuits upon baking and attributed this to the Maillard reaction (non-enzymatic browning). Under drying conditions, presence of reducing sugars and protein contents had been reported to affect the surface browning. In the present study, during frying of meat *samosas*, moisture loss took place from *samosa* sheet and this dehydration of sheet could have resulted in increased browning.

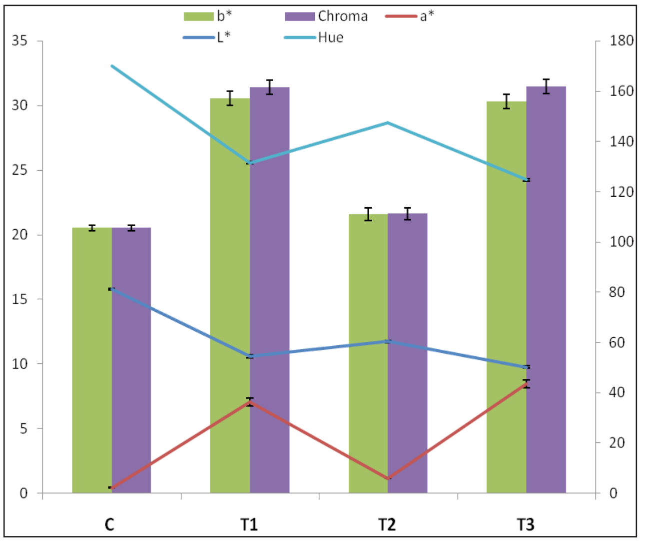

Fig. 1: Instrumental colour profile of chicken meat *samosa*

n=6, C= control, raw chicken meat *samosa*, T1, T2 and T3 are *samosa* deep fat fried at 185 ºC for 6 min, 2 min and 2+5 min, respectively.

Sensory evaluation

Sensory attributes such as appearance and colour, flavour, texture, meaty flavour intensity and overall acceptability of T1 and T3 samples are graphically presented in Fig 2. The appearance and colour score of T1 and T3 were comparable with T1 having higher appearance and colour score. This could be due to overall longer frying duration for T3 samples leading to excessive/ dark browning, which was not preferred by panellists. The results are in agreement with instrumental colour profile of chicken meat *samosas*. Flavour scores of T1 was recorded significantly (P<0.05) higher than T3. This could be due to longer frying duration, leading to formation of non-volatile lipid oxidation compounds due to oxidation and polymerization of unsaturated fat (Boskou, 2002). The volatile lipid oxidation compounds increased during beginning of frying and these compounds could have marked impact on flavour of fried product. Frying for long duration resulted in accumulation of undesirable substances of food particles and oxidative compounds of oil (Debarganes *et al*., 2000; Jorge *et al*., 2005). These could be the reason behind lower flavour score of T3 samples. Similarly, sensory panelist sensed higher meaty flavour intensity for T1 *samosa* than T3 *samosa*.

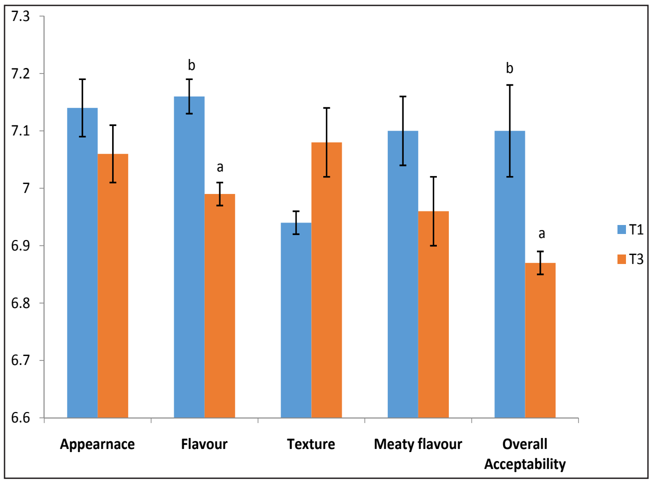

Fig. 2: Sensory attributes of chicken meat *samosa*

n=36, C= control, raw chicken meat *samosa*, T1, T2 and T3 are *samosa* deep fat fried at 185 ºC for 6 min, 2 min and 2+5 min, respectively.

Texture scores of T1 and T3 samples were comparable, however T3 samples exhibited higher texture value. During frying several changes happened in *samosa* such as removal of moisture leading to crust formation, denaturation of protein, starch gelatinization, formation of pores/ crispiness due to sudden evaporation of moisture,etc (Bordin *et al*., 2013). The crust formed acts as barrier for further evaporation of moisture from *samosa* mix. These pores had direct effect on texture and acceptability of pores. The overall acceptability of T1 was significantly (P<0.05) higher than T3. This could be due to better appearance and colour, flavour and meaty flavour of T1 samples. The overall acceptability of T3 *samosa* was affected due to higher oil absorption and longer frying duration leading to impact on flavour and appearance.

CONCLUSION

Good quality chicken meat *samosas* could be prepared by incorporating 50% minced chicken meat in *samosas* mixture. Thus, it can be concluded that chicken meat *samosa* cooked by deep fat frying at 185ºC for 6 min maintained better quality attributes and sensory parameters.

Conflict of Interest: Authors declare no conflict of interest.

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