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Research Article

SHELF STABILITY OF CONVENIENCE AND READY TO EAT CHICKEN MEAT MINCE INCORPORATED COOKIES

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ABSTRACT

The study was conducted to develop cookies incorporated with chicken meat mince (CMM) at 10 to 50 per cent level. On the basis of sensory evaluation, the optimum level of CMM to be incorporated in cookies was selected. Of the various levels of CMM tried; the cookies with 10% CMM were preferred the most. The chicken meat mince incorporated cookies had desirable organoleptic properties. It was concluded that the cookies with 10% chicken meat mince and 90% refined wheat flour were ready to eat food, provided a nutritious diet, and could be stored for 90 days at ambient temperature without any significant deterioration in microbiological quality. There cookies also had acceptable sensory attributes.

Key words: Cookies, chicken meat mince, refined wheat flour, organoleptic properties, shelf life

Convenience foods have played a vital role in the life of human beings and the products like breads, biscuits, cakes, chapattis and other ethnic foods are highly relished. Growing urbanization, increasing trend of working women, changing socio-economic status and life styles have also contributed to the enhanced consumption of processed and convenience meat products.

Majority of cookies available in the market are based on refined wheat flour, which is inadequate in quantity as well as quality proteins. Lack of high quality proteins is one of the most common causes of nutritional deficiencies. Wheat protein is considered nutritionally poor and snacks based on cereals and grains are low in nutrient density, high in calorie and fat content and lack some essential amino acids like threonine, tryptophan and lysine. Chicken meat is rich in threonine, tryptophan and lysine.

Meat incorporated foods are highly perishable and a preservation method such as dehydration can extend the shelf life of such food products. The palatability of dehydrated meat products can be improved by alterations in the formulation and by appropriate processing. Use and functionality of wheat flour, fortified with legume flour, defatted soya flour, corn or rice flour, textured soya protein, fish meat, fish and milk protein concentrates, cotton seed or other protein rich additives in preparing and increasing the nutritive value of cookies have been documented (Singh *et al*., 2000; Gupta, 2001; Garg, 2001; Lovis, 2003).

Chicken meat is considered relatively leaner and there is no social taboo associated to its consumption, making it the most preferred meat in India. In our country chicken meat is mostly consumed as curry, but the convenient, ready to eat and shelf stable products are in great demand. With this aim the cookies incorporated with chicken meat mince (CMM) were developed, but relatively no organized research and information is available on incorporated cookies.

MATERIALS AND METHODS

Broiler Chickens: Broiler birds of six weeks of age reared under similar feeding and management conditions were obtained from the Poultry Farm of the University.

Ingredients: Fresh refined wheat flour (RWF) i.e. Maida used in the study was procured from the local market and was packed in air tight containers for further use. The vegetable oil free from argemon (labelled) (Amrit Banaspati Co. Ltd, Rajpura, Punjab) was procured from the local market. Sugar powder and iodized table salt (2%) (Tata Chemicals Ltd., Mumbai) were procured from the local market and stored in air tight jar for subsequent use. Fresh buffalo milk and fresh hen eggs were obtained from the University.

Spice Mix: To prepare spice mix, different fresh spice ingredients were procured from the local market, cleaned

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and then warmed in a hot air oven at 50±2°C for 2 hours. The ingredients were then ground in an Inalsa grinder and sieved through U.S. 30 mesh screen. Spice mix was prepared by mixing the powdered spices in a formulation as given in Table 1 and was stored in a PET (polyethylene terephthalet) jar for subsequent use.

Packaging Material: Low density polyethylene (LDPE) pouches were used for anaerobic packaging for the storage studies.

Slaughter of Birds: The birds were slaughtered according to the procedure outlined by Panda (1995) following stunning. The birds were eviscerated and washed thoroughly. Carcasses were deboned manually and deboned meat was packaged in LDPE bags and stored in a deep freezer at -18±1°C for further studies. The portion of frozen meat required for the experiment was taken out and kept at refrigeration temperature (4±1°C) overnight for partial thawing and subsequently minced in a meat mincer and used.

Preparation of CMM: The deboned frozen meat was minced in an electrical meat mincer and then thoroughly kneaded for the preparation of CMM incorporated cookies.

Table 1
Spice mix formulation

Name of ingredient	Percentage (w/w)
Caraway seeds (*Ajwain*)	10
Black pepper (*Kalimirch*)	10
Cumin seeds (*Zeera*)	15
Coriander (*Dhania*)	15
Aniseeds (*Soanf*)	10
Cloves (*Laung*)	5
Mace (*Javitri*)	7
Cardamon dry (*Badi Elaichi*)	5
Cardamom dry (*Chhoti Elaichi*)	3
Capsicum (*Mirch powder*)	7
Dry ginger powder (*Soanth*)	5
Cinnamon (*Dalchini*)	5
Nutmeg (*Jaifal*)	3
Total	**100**

Preparation of CMM Incorporated Cookies: Six types of cookies were prepared using different levels of RWF, CMM, sugar, shortening and other ingredients as given in the Table 2. All the ingredients were mixed in the bowl mixer for 2-3 minutes to make homogenous emulsion. Then the prepared emulsion was put into cookies dropping bag having stainless steel nozzle of desired shape at the end. The emulsion was put in steel pan or trays and baked in preheated hot air oven at 160ºC for 15-20 minutes or till golden brown, cooled and then packed in LDPE pouches**.** The pouches were sealed by using hand sealer model Pack Seal 1196 (Max Pack, Pune, India) and stored at an ambient temperature of 25±2ºC for up to 3 months and drawn periodically in 15 days interval for quality evaluation.

Sensory Evaluation: The sensory quality attributes of the cookies were evaluated by semi trained panelists using 9- point hedonic scale.

Microbiological Quality: The microbiological quality of the cookies was assessed by enumerating standard plate count (SPC), coliforms counts and yeast and moulds counts using standard procedure of APHA (1984).

RESULTS AND DISCUSSION

Optimizations of Level of CMM in Cookies: Sensory scores of CMM incorporated cookies with different levels of CMM are presented in Table 3. Mean score of colour and appearance for control cookies was 8.22 which increased significantly to 8.47 on incorporation of 10% CMM. A significant decrease from 8.47 to 5.48 was observed on incorporation of 20 to 50% CMM. Flavour score of CMM incorporated cookies increased significantly from 7.56 (control) to 8.43 (50% CMM).

Crispness score decreased non-significantly from 7.72 (control) to 7.59 (10% CMM), but on further incorporation of 20 to 50% CMM, the score decreased significantly. Mean score of taste for control cookies was 7.61 which increased significantly to 8.45 on incorporation of 10% CMM, but deceased significantly on further incorporation of CMM.

Taste and overall acceptability scores were observed significantly low for 50% CMM and were significantly high for 10% CMM. As the cookies (CP10) having 10% CMM showed the highest scores amongst CMM incorporated cookies, it was selected for further studies.

There was no significant difference in colour scores of cookies incorporated with CMM at 10 and 20% levels. The color scores decreased significantly on further incorporation up to 50% CMM. This might be due to case hardening at high temperature (160°C) during baking.

Flavour scores of cookies significantly increased

Table 2
Formulation of developed cookies made with different levels of chicken meat mince

Ingredients (g)	CC (Control)	CM10 (10% CMM)	CM 20 (20% CMM)	CM 30 (30% CMM)	CM 40 (40% CMM)	CM 50 (50% CMM)
Refined wheat flour	100	90	80	70	60	50
Chicken meat powder	0	10	20	30	40	50
Shortening/Veg.ghee	40	40	40	40	40	40
Sugar powder	25	25	25	25	25	25
Whole liq.egg (hen)	15	15	15	15	15	15
Spice mix	0.6	0.6	0.6	0.6	0.6	0.6
Table salt	1.5	1.5	1.5	1.5	1.5	1.5
Baking powder	1	1	1	1	1	1
Buffalo milk	25 ml	25 ml	20 ml	15 ml	10 ml	7 ml
Vanilla essence	5 drops	5 drops	5 drops	5 drops	5 drops	5 drops
Coloring agent (orange red sol.1%)	3 ml	3 ml	3 ml	3 ml	3 ml	3 ml

CC=control cookies, CM=cookies made with chicken meat mince

with the increased level of CMM which might be due to meat flavour intensity. Crispness scores decreased significantly at 20% and at more CMM levels, however at 30% CMM level, texture score of cookies was 5.85 which was lower than 6.00 i.e. slightly like. That may be due to higher water activity of meat than control (refined flour). Texture or crispness of snack (cookies) is one of the most important characteristics affecting consumer acceptance. Snack products lost crispness when water activity exceeded 0.35 to 0.5, depending on the products (Kartz and Labuza, 1981).

Taste and overall acceptability scores of cookies increased significantly up to 10% CMM but decreased significantly thereafter. Based on sensory evaluation, the overall acceptability of cookies incorporated with CMM was found up to 20% level, but optimum level of CMM incorporation was 10%.

Quality Changes During Storage: The moisture content and crude protein contents of cookies increased significantly ($P \leq 0.05$) with an increase in the level of CMM incorporation (Table 4). Crude protein content of CMM incorporated (10%) cookies was found to be 11.18%. Similarly crude fat and ash content of cookies increased significantly ($P \leq 0.05$) with an increase in the level of CMM incorporation (Table 4). There was a significant increase in moisture content of cookies incorporated with 10% CMM as compared to control treatment, which might be due to high moisture content of CMM as compared to refined wheat flour. This finding was in accordance with the observation of Sharma and Nanda (2002) who also observed maximum moisture in chicken chips with highest meat level.

Microbiological Status During Storage at 25±2°C: The SPC followed a gradual increasing pattern from 0 to 30th day in control and CMM incorporated cookies, however, the values were very low (0 to 18 cfu/g) and were within the permissible limits for cooked meat products as prescribed by Jay (1996) (Table 5).

Table 3
Sensory characteristics of chicken incorporated cookies with different levels of chicken meat mince

Sensory parameter	Chicken meat mince (CMM) incorporated cookies					
	CC (Control)	CM 10 (10% CMM)	CM 20 (20% CMM)	CM 30 (30% CMM)	CM 40 (40% CMM)	CM 50 (50% CMM)
Colour and appearance	$8.22^{a}\pm0.10$	$8.47^{a}\pm0.09$	$7.98^{a}\pm0.14$	$6.60^{b}\pm0.21$	$5.70^{c}\pm0.27$	$5.48^{c}\pm0.28$
Flavor	$7.56^{c}\pm0.10$	$7.91^{bc}\pm0.12$	$7.96^{bc}\pm0.22$	$8.20^{ab}\pm0.11$	$8.40^{a}\pm0.16$	$8.43^{a}\pm0.13$
Texture/Crispness	$7.72^{a}\pm0.64$	$7.59^{ab}\pm0.10$	$7.15^{b}\pm0.13$	$6.40^{c}\pm0.18$	$5.85^{d}\pm0.22$	$4.76^{e}\pm0.18$
Taste	$7.61^{b}\pm0.45$	$8.45^{a}\pm0.11$	$7.85^{b}\pm0.13$	$6.45^{c}\pm0.24$	$5.60^{d}\pm0.25$	$4.86^{e}\pm0.23$
Overall acceptability	$7.97^{b}\pm0.08$	$8.54^{a}\pm0.10$	$7.65^{b}\pm0.18$	$6.20^{c}\pm0.24$	$5.25^{d}\pm0.26$	$4.67^{e}\pm0.22$

Mean±S.E. with different small letter superscripts in a row within each parameter differ significantly ($P \leq 0.05$); n=6

Table 4
Proximate composition (per cent, on fresh basis) of developed chicken meat mince incorporated cookies

Treatments	Proximate composition (%)			
	Moisture	Crude protein	Crude fat	Ash
CC	$3.12^{a}\pm0.03$	$9.66^{b}\pm0.04$	$22.52^{b}\pm0.01$	$0.96^{b}\pm0.04$
CM 10	$2.67^{a}\pm0.02$	$11.18^{a}\pm0.01$	$23.58^{a}\pm0.05$	$1.11^{a}\pm0.05$

Mean±S.E. with different superscripts in a column for a parameter differ significantly ($P\leq0.05$); n = 6; CMM = Chicken meat mince

Low initial count might be due to thermal processing at higher temperature (baking at 160°C) and low moisture content, hygienic practices during processing, storage and handling of the product as earlier reported by Grohs and Kunz (1999) and Grohs *et al.* (2000). Modi *et al.* (2007) reported similar results during storage of dehydrated chicken kebab mix and observed it to be microbiologically safe as indicated by very low initial bacterial counts and absence of coliforms throughout the storage period of 6 months.

The SPC values increased gradually by 75th day in both control and CMM incorporated cookies. This might be due to multiplication of microorganisms during storage (Bawa *et al*., 1988). A similar increase in SPC on storage was reported by Nag *et al*. (1998) in chicken nuggets extended with rice. On day 90 of storage the SPC counts slightly decreased in cookies.

Coliforms were not detected in all CMM incorporated and the control cookies during the storage up to 90 days. It could be due to destruction of these bacteria during cooking and baking. Further, hygienic practices followed during and after preparation of the products could be the additional reasons for the absence of coliforms. Similar findings were also observed by Modi *et al*. (2007) in dehydrated chicken kebab mix during storage for 6 months.

Yeast and mould growth was only detected after 60th day of storage and had very less growth (3 to 9 cfu/g) in CMM incorporated cookies throughout the storage period (Table 5). Yeast and mould counts were found slightly higher in control (refined wheat flour) cookies than the CMM incorporated cookies during storage up to 90 days. This was probably due to presence of higher amount of carbohydrates in control (refined wheat flour) cookies which is a good substrate for growth of yeast and mould. A similar increase in yeast and mould count had been reported by Modi *et al*. (2007) in dehydrated chicken kebab mix during storage at ambient temperature.

Sensory Evaluation During Storage at 25±2°C: There was non-significant difference in colour and appearance during the storage period but the scores slightly declined up to 90 days in all cookies. The scores for colour and appearance were significantly higher in chicken incorporated cookies as compared to the control (Table 6). This might be due to some pigment oxidation and non-enzymatic browning resulting from reaction between lipid oxidation products and amino acids (Che Man *et al*., 1995) as well as surface dehydration in aerobic packaging. A similar decline in colour scores during storage has been reported by Singh *et al*. (2002) and Modi *et al*. (2007) in dehydrated chicken snacks and dehydrated chicken kebab mix, respectively. At the end of the storage, all the colour scores of control and chicken incorporated cookies were well within the acceptability range.

There was a non-significant decrease in the flavour scores of control as well as chicken incorporated cookies and the decrease might be due to increased lipid oxidation resulting in malonaldehyde formation, liberation of free fatty acids and increased microbial load (Suresh *et al.*, 2003; Kumar and Sharma, 2004). Meat flavour intensity

Table 5
Standard plate count and yeast and mould count of chicken meat mince incorporated cookies during storage at ambient temperature (25±2°C)

Count	Product	Storage (days)						
		0	15	30	45	60	75	90
Standard plate count (cfu/g)	CC	2±0.40	3±0.51	7±0.81	7±0.81	10±0.63	13±0.52	12±0.40
	CM10	3±0.51	5±0.54	7±0.81	12±0.75	13±0.51	16±0.75	20±0.89
Yeast and mould count (cfu/g)	CC	ND	ND	3±0.81	7±0.81	3±0.51	5±0.54	5±0.83
	CM10	ND	ND	ND	ND	3±0.51	4±0.54	3±0.51

ND=Not detected; CMM=Chicken meat mince; CC=Control cookies; CM10=Cookies with 10% CMM

Table 6
Effect of storage on organoleptic scores of chicken meat mince incorporated cookies during storage at ambient temperature (25 ± 2°C)

Parameter	Product	Storage (days)						
		0	15	30	45	60	75	90
Colour and appearance	CC	$8.22^{aB}\pm0.16$	$8.11^{aAB}\pm0.11$	$8.02^{abB}\pm0.08$	$7.94^{abcAB}\pm0.10$	$7.78^{abcB}\pm0.16$	$7.61^{bcB}\pm0.16$	$7.56^{cB}\pm0.17$
	CM10	$8.50^{aA}\pm0.18$	$8.44^{aA}\pm0.17$	$8.33^{aA}\pm0.14$	$8.28^{aA}\pm0.14$	$8.22^{aA}\pm0.12$	$8.22^{aA}\pm0.14$	$8.05^{aA}\pm0.17$
Flavour	CC	$7.61^{aB}\pm0.13$	$7.56^{aB}\pm0.15$	$7.50^{aB}\pm0.16$	$7.44^{aB}\pm0.17$	$7.39^{aB}\pm0.16$	$7.33^{aB}\pm0.16$	$7.22^{aB}\pm0.22$
	CM 10	$7.89^{aB}\pm0.20$	$7.83^{aB}\pm0.20$	$7.72^{aB}\pm0.14$	$7.67^{aB}\pm0.23$	$7.61^{aB}\pm0.16$	$7.56^{aB}\pm0.17$	$7.50^{aB}\pm0.16$
Texture/Crispness	CC	$7.83^{aB}\pm0.20$	$7.78^{aB}\pm0.22$	$7.72^{aB}\pm0.22$	$7.67^{aB}\pm0.23$	$7.56^{aB}\pm0.17$	$7.50^{aB}\pm0.16$	$7.44^{aB}\pm0.17$
	CM 10	$7.61^{aB}\pm0.16$	$7.56^{aB}\pm0.15$	$7.50^{aB}\pm0.16$	$7.44^{aB}\pm0.15$	$7.39^{aB}\pm0.16$	$7.33^{aB}\pm0.16$	$7.22^{aB}\pm0.14$
Taste	CC	$7.61^{aB}\pm0.16$	$7.56^{aB}\pm0.17$	$7.44^{aB}\pm0.17$	$7.33^{aB}\pm0.17$	$7.28^{aB}\pm0.22$	$7.22^{aB}\pm0.14$	$7.11^{aB}\pm0.11$
	CM 10	$8.44^{aA}\pm0.17$	$8.39^{aA}\pm0.16$	$8.33^{aA}\pm0.14$	$8.27^{aA}\pm0.12$	$8.22^{aA}\pm0.14$	$8.16^{aA}\pm0.18$	$8.11^{aA}\pm0.11$
Overall acceptability	CC	$8.06^{aB}\pm0.10$	$7.94^{aB}\pm0.17$	$7.83^{aB}\pm0.20$	$7.72^{aB}\pm0.14$	$7.67^{aB}\pm0.17$	$7.61^{aB}\pm0.16$	$7.56^{aB}\pm0.17$
	CM 10	$8.56^{aA}\pm0.15$	$8.50^{aA}\pm0.14$	$8.44^{aA}\pm0.15$	$8.33^{aA}\pm0.17$	$8.28^{aA}\pm0.14$	$8.17^{aA}\pm0.11$	$8.11^{aA}\pm0.20$

Mean±S.E. with different capital letter superscripts in a column and small letter superscripts in a row for each parameter differ significantly ($P\leq0.05$); n=6; CC=Control cookies; CM10=Cookies with 10% CMM

scores were significantly higher in cookies incorporated with 10% CMM as compared to control cookies. This observation is in confirmity with the study of Singh *et al*. (2002) who observed that chicken snacks with highest meat level had maximum flavour scores.

The texture/crispness of snacks is one of the most important characteristics affecting consumer acceptance. Matz (1993) noted that the texture of potato chips was dependent on the composition of raw material, thickness of slice and moisture content of the product. The water activity of the snack products affects the acceptability of sensory crispness. Snack products lost crispness when water activity exceeded 0.35 to 0.5 depending on the product (Kartz and Labuza, 1981). A non-significant decline in crispness scores of control and CMM incorporated cookies during storage (Table 6) might be due to loss of moisture during storage and degradation of muscle fiber protein by bacterial action (Jay, 1996) resulting in decreased water binding capacity. A similar decrease in texture scores during storage at ambient temperature had also been reported by Singh *et al*. (2002) and Modi *et al*. (2007) in fish snack, chicken snack and dehydrated chicken kebab mix, respectively.

It can be concluded from this study that the convenient and ready to eat cookies can be developed by incorporation of 10% chicken meat mince with good shelf stability and storage for three months at ambient temperature without affecting their sensory attributes.

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