Production of Value Added Chicken Meat Mince Incorporated Cookies and Their Cost Economics - Benefit Ratio

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In the present study, chicken (broiler) meat mince was used as protein sources. Incorporation of chicken meat mince at 10, 20, 30, 40 and 50 per cent level were tried besides other ingredients which were added in control. Chicken cookies incorporated with 10 per cent CMM were preferred the most on the basis of their sensory evaluation. As the chicken incorporated cookies have not been reported in India and abroad. Majority of cookies available in market are prepared from cereal (refined wheat flour), which has very low protein content and lack lysine, threonine and tryptophan essential amino acids. The cookies thus developed can contribute good amount of nutrients especially protein if consumed in place of cereal (refined wheat flour) cookies. The developed products can be used for feeding programmes at institutes and school going children and elderly people, who are more prone to malnutrition particularly due to protein with essential amino acids deficiency. Chicken meat is also rich in threonine, tryptophan and lysine. Thus development of chicken incorporated biscuits and cookies using chicken meat and wheat flour would provide a nutritious, convenient and ready to eat food item. With an aim to develop biscuits and cookies by incorporating the chicken meat, the present study was planned

It was concluded that the cookies with 10 per cent chicken meat mince and wheat flour would provide a nutritious with sufficient amount of essential amino acids (lysine, tryptophan and threonine), convenient and ready to eat food item. The cost of production of cookies with 10 per cent CMM worked out to be Rs. 77.60 per kg.

Keywords: Cookies, chicken meat mince, refined wheat flour, essential amino acids, cost economics

Introduction

The word cookie comes from Dutch word *'koekje'* meaning 'little cake'. The word cookie is used only in North America. In Britain, these little cakes are known as biscuits, although English biscuits are usually smaller than North American cookies and almost crisp rather than soft and chewy. Biscuits and cookies are generally accepted snacks and eaten with tea by people in India. Children eat these baked products readily; mothers use them as pacifiers and sick people often relish biscuits and cookies rather than other foods (Vaidehi *et al.*, 1985).

Convenience foods have played a vital role in the life of human beings since antiquity. Technological advancement, particularly in the field of processing equipments, processes and packaging materials have brought revolution in the development of convenience foods; as per the necessity, taste as well as nutritional requirements of a large section of the population. The convenience products like breads, biscuits, cakes, chapattis and other ethnic foods are highly relished and have proven to be useful (Sharma and Bawa, 2003) Amongst processed foods; the demand for shelf stable snack foods is increasing day by day. Snack, defined as a light meal eaten between regular meals, include a broad range of products. Work roles, family organization, and lifestyle changes are causing food intake to become more irregular, often without fixed meal times, away from home and between meals (Poulain, 2002 and Mestdog, 2005).

Many people in developing countries subsist on cereal grains; which are often inadequate in quantity as well as quality of proteins. Lack of the high quality proteins is one of the most widespread nutritional deficiencies. The lower the quality of protein, greater the amount of such protein required to maintain nitrogen balance. Gelatin protein will not provide nitrogen balance at any quantity fed because of absence of essential amino acids. Since it has been often demonstrated that there is a lower requirement of protein if the quality is high, it becomes apparent that high quality protein blends can be consumed in less total food intake than lower quality protein products to provide necessary nutrition.

Wheat protein is considered nutritionally poor and snacks

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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 (Jean et al., 1996). Greater interest has, therefore, been aroused in developing acceptable value added protein enriched and energy dense cookies especially for overcoming the problem of protein energy malnutrition which is quite prevalent among low income group children in India. Nutritionally, cookies can be easily incorporated with protein rich flours to provide a convenient food to supplement the poor quality diets.

Although the 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 (Suknark *et al.*, 1998 , Singh *et al.*, 2000, Gupta, 2001, Garg, 2001 and Lovis, 2003) in preparing and increasing the nutritive value of biscuits and cookies have been documented but relatively no organized research and information is available on chicken meat mince incorporated cookies in India as well as abroad.

Materials And Methods:

Broiler chickens

Broiler birds of same age (six weeks) reared under similar feeding and manage- mental conditions were obtained from the Poultry Farm, College of Veterinary Sciences, Lala Lajpat Rai University of Veterinary and Animal Sciences (LLRUVAS), Hisar.

Refined wheat flour

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.

Shortening / dehydrogenated fat

The vegetable oil free from argemon (labelled) Gagan refined vegetable oil of brand Amrit Banaspati Co. Ltd, Chandigarh Road, Rajpura (Punjab) was procured from the local market.

Sugar powder

Sugar powder was procured from the local market and stored in air tight jar for subsequent use.

Milk

Fresh buffalo milk was obtained from the department of LPT, COVS. LLRUVAS for use in the preparation of cookies.

Eggs

Fresh hen eggs were obtained from the layer farm of Department of Livestock Production Management. COVS, LLRUVAS.

Salt

Iodized table salt (2%) (Tata salt, Tata Chemicals Ltd., Mumbai) was procured from the local market and stored in moisture free PET (polyethylene terephthalet) jar for subsequent use.

Spice mix

To prepare spice mix, different fresh spice ingredients were procured from the local market, cleaned 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 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 in the slaughter house of the department according to the procedure outlined by Panda (1995) following stunning by giving hard blow on the head. After a period of 1.5 minutes for bleeding, the skin was removed manually along with feathers. The birds were eviscerated and washed thoroughly. Carcasses were deboned manually and deboned meat was packaged in low density polyethylene (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 Chicken Meat Mince (CMM)

The deboned frozen meat was minced through an electrical meat mincer and then thoroughly kneaded for preparation of chicken meat mince incorporated cookies.

Preparation of chicken incorporated cookies with different levels of CMM

Six types of cookies were prepared by using different levels of refined wheat flour (RWF), chicken meat mince (CMM), sugar, shortening and other ingredients as given in the tables 2. Spice mix was used according to the formulation given in the Table 1. 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 the dropped in steel pan or trays and baked in preheated hot air oven at 160 °C for 15-20 min or till golden brown, then cooled and packed with the same method as given under preparation of chicken meat mince incorporated cookies.

Results and Discussion

Selection of optimum level of chicken meat minces in the developed cookies.

Sensory scores of chicken incorporated cookies with

different levels of chicken meat mince are presented in Table 3.

Mean score of colour and appearance for control cookies was 8.22 and was increased significantly to 8.47 on incorporation of 10 per cent CMM, but the significant decrease was observed on further incorporation of 20 to 50 per cent CMM, scores decreased from 8.47 to 5.48, respectively. Flavour score of CMM incorporated cookies increased significantly from 7.56 (control) to 8.43 (50 per cent CMM). Crispness score was decreased non significantly from 7.72 (control) to 7.59 (cookies 10 per cent CMM), but on further incorporation of 20 to 50 per cent CMM, the score decreased significantly from 7.15 to 4.76 respectively. Mean score of taste for control cookies was 7.61 and was significantly increased to 8.45 on incorporation of 10 per cent CMM, but deceased significantly on further incorporation of CMM. Taste and overall acceptability scores were observed significantly low (4.86 and 4.67) for 50 per cent CMM and were significantly high (8.45 and 8.54) for 10 per cent CMM incorporation level, respectively. As the cookies (CP10) having 10 per cent CMM showed higher scores amongst CMM incorporated cookies (Table 3). It was selected for further studies.

There was no significant difference in colour scores of cookies incorporated with chicken meat mince (CMM) at 10 and 20 per cent level. 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. This finding was in accordance with observation of Bate Smith *et al.* (1943).

Flavour scores of g cookies significantly increased with the increased level of CMM incorporation. This might be due to meat flavour intensity that increases with the increased level of meat. Crispiness scores decreased significantly at 20% and more CMM level of incorporation in cookies, but on incorporation of 30% CMM level, texture score of cookies was 5.85 which is lower than 6.00 i.e. slightly like. That may be due to higher water activity of meat than control (refined flour). Texture or crispiness of snack (cookies) is one of the most important characteristics affecting consumer acceptance. Snack products lost crispiness 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 after that decreased significantly to below 7.0 at 30% and below 6.0 at 40% CMM level of incorporation, i.e. slightly like or non acceptable. Based on sensory evaluation, the overall acceptability of cookies incorporated with CMM was found up to 20 per cent level, but optimum level of CMM incorporation was 10 per cent.

Proximate composition of raw ingredients used for making chicken meat mince incorporated cookies

The moisture content, crude protein, crude fat and ash content of the raw material used in the study has been presented in Table 4.

Moisture content of chicken meat mince (CMM) and refined wheat flour (RWF) was 72.21 and 13.30 per cent, respectively. CMM had higher percent protein, fat and ash content (24.80, 1.58 and 3.39 per cent) than RWF (10.80, 0.89 and 0.59 per cent), respectively The moisture content of chicken meat mince was significantly higher as compared to refined wheat flour and chicken meat powder, but the crude protein, crude fat, and ash content of chicken meat powder were significantly higher as compared to chicken meat mince and refined wheat flour.

Proximate composition of chicken (broiler) meat mince is in close proximity to values reported by previous research workers (Lorenz (1983; Kondaiah and Panda, 1992; Hooda, 2002; Gopalan *et al.*, 2007 and Surender kumar, 2009).

Proximate composition of selected cookies incorporated with different levels of chicken meat mince (CMM)

The moisture content of control cookies was 3.12 per cent which increased significantly ($P \leq 0.05$) with an increase in level of CMM incorporation (Table 5). Crude protein content of control cookies was found to be 9.66 per cent which increased significantly ($P \leq 0.05$) with an increase in level of chicken meat incorporation (Table 5). Crude protein content of chicken incorporated cookies was found 11.18 per cent in cookies (CM10) with 10 per cent incorporation of chicken meat mince.

Similarly crude fat and ash content of control cookies was 22.52 per cent fat and 0.96 per cent ash, respectively which increased significantly ($P \leq 0.05$) with an increase in level of CMM incorporation (Table 4.6). The crude fat content of cookies CM10 was found 23.58 per cent.

Ash content was found 1.11 per cent in cookies (CM10) with 10 per cent incorporation level of chicken meat mince.

There was significant increase in moisture content of cookies incorporated with 10 per cent CMM as compared to control treatment, which might be due to high moisture content of CMM as compared to refined wheat four (control). The finding was in accordance with the observation of Sharma and Nanda (2002), who observed maximum moisture in chicken chips with highest meat level.

Amino acids

Data pertaining to amino acids content of chicken incorporated cookies is presented in table 6.

Lysine content of chicken meat mince incorporated cookies CM10 with 10 per cent CMM was 2.61g / 100g CP, which was higher than that of their control cookies (CC), which was 2.61 g / 100g CP.

Tryptophan content of chicken cookies CM10 was recorded 1.38 g/ 100g CP, which was higher than control cookies (CC)

1.35 g/ 100g crude protein.

Threonine content of chicken incorporated cookies CM10 was found to be 3.13 g/100g CP, which was higher than the control cookies (2.71g/100g CP).

Threonine content of chicken meat mince cookies incorporated with CMM was higher than their control cookies. The findings were in accordance with Sunil, 2012 and Padhye and Salunkhe, (1978) in chicken powder enriched idli.

Higher lysine, tryptophan and threonine content of CMM incorporated chicken cookies may be due to chicken meat mince. The higher level of lysine, tryptophan and threonine content of chicken cookies may be due to CMM, CMP, buffalo milk and whole eggs used for preparation of dough emulsion of cookies as reported by Jorfi *et al.* (2012) and Lunven *et al* .(1973).

F A O (1970) also reported 487, 278 and 88 mg / g N lysine, threonine and tryptophan amino acids in cow milk, respectively.

Cost benefit ratio of cookies incorporated with chicken meat mince

Cost of processing of cookies incorporated with 10 per cent CMM and control cookies were calculated. Capital investment for production of 15000 kg of cookies incorporated with 10 per cent chicken meat mince annually was Rs.253750 (Table 7.) with depreciation of Rs. 25395.

Detailed break up of processing cost, fixed charges and general expenses are presented in Table 8. It was assumed that total quantity of broiler deboned meat processed for preparation of cookies incorporated with 10 per cent CMM in one year to produce 50 kg per day each year was 1500 kg. The cost and weight of all the added ingredients like refined wheat flour, vegetable ghee, sugar, common salt, spice mix, milk, coloring agent, baking soda and essence etc. were also taken into consideration to calculate the final cost of each product.

The final cost of each product per kg was calculated which is presented in Table 8. The cost of control cookies per kg was Rs.63.72. whereas the cost of cookies incorporated with 10 per cent CMM was calculated as Rs.77.60

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Table 1 Spice mix formulation

Sr. No.	Name of ingredient	Percentage (w/w)
1	Caraway seeds (*Ajwain*)	10
2	Black pepper (*Kalimirch*)	10
3	Cumin seeds (*Zeera*)	15
4	Coriander (*Dhania*)	15
5	Aniseeds (*Soanf*)	10
6	Cloves (*Laung*)	5
7	Mace (*Javitri*)	7
8	Cardamon dry (*Badi Elaichi*)	5
9	Cardamom dry (*Chhoti Elaichi*)	3
10	Capsicum (*Mirch powder*)	7
11	Dry ginger powder (*Soanth*)	5
12	Cinnamon (*Dalchini*)	5
13	Nutmeg (*Jaifal*)	3
	Total	**100**

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

INGREDIENTS (g)	CC	CM10	CM 20	CM 30	CM 40	CM 50
	Control	10% CMM	20% CMM	30% CMM	40% CMM	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
Milk (buffalo)	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

Table :3 Sensory characteristics of chicken incorporated cookies with different levels of chicken meat mince (CMM).

Sensory Parameter	Chicken meat mince (CMM) incorporated cookies					
	CC	CM 10	CM 20	CM 30	CM 40	CM 50
	Control	10% CMM	20% CMM	30% CMM	40% CMM	50% CMM
Colour and appearance	8.22^{a} + 0.10	8.47^{a} + 0.09	7.98^{a} + 0.14	6.60^{b} + 0.21	5.70^{c} + 0.27	5.48^{c} + 0.28
Flavor	7.56^{c} + 0.10	7.91^{bc} + 0.12	7.96^{bc} + 0.22	8.20^{ab} + 0.11	8.40^{a} + 0.16	8.43^{a} + 0.13
Texture / Crispness	7.72^{a} ± 0.64	7.59^{ab} ± 0.10	7.15^{b} ± 0.13	6.40^{c} ± 0.18	5.85^{d} ± 0.22	4.76^{e} ± 0.18
Taste	7.61^{b} + 0.45	8.45^{a} + 0.11	7.85^{b} + 0.13	6.45^{c} + 0.24	5.60^{d} + 0.25	4.86^{e} + 0.23
Overall acceptability	7.97^{b} ± 0.08	8.54^{a} ± 0.10	7.65^{b} ± 0.18	6.20^{c} ± 0.24	5.25^{d} ± 0.26	4.67^{e} ± 0.22

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 of raw materials (percent, on raw basis) used for ma king chicken meat mince incorporated cookies.

Parameter (%)	Refined wheat flour (RWF)	Chicken meat mince (CMM)
Moisture	13.30^{b} ±0.02	72.21^{a} ±0.03
Crude protein	10.80^{b} ±0.03	24.80^{a} ±0.04
Crude fat	0.89^{b} ±0.01	1.58^{a} ±0.03
Ash	0.59^{b} ±0.01	3.39^{a} ±0.03

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

Table :5 Proximate composition (per cen t, on fresh basis) of developed chicken meat mince incorporated cookies.

Treatments	COOKIES			
	Moisture	**Crude protein**	**Crude fat**	**Ash**
CC Control cookies	3.12^{b} ±0.03	9.66^{c} ± 0.04	22.52^{c} ±0.01	0.96^{c} ±0.04
CM 10 Cookies made with 10%CMM	2.67^{b} ±0.02	11.18^{b} ±0.01	23.58^{b} ± 0.05	1.11^{b} ±0.05

Mean ± S.E. with different small letter superscripts in a column within each parameter (within each product) differ significantly ($P \leq 0.05$); n = 6
CMM = Chicken meat mince,

Table :6 Amino acid composition (per cent crude protein) of developed chicken meat mince incorporated cookies.

Product	Amino acid composition (per cent crude protein)		
	Lysine	**Tryptophan**	**Threonine**
CC Control cookies	**2.61**	**1.35**	**2.71**
CM 10 Cookies made with 10%CMM	**2.80**	**1.38**	**3.13**

Values are average mean of duplicate samples
CMM = Chicken meat mince,

Table :7 Major capital investment with cost and annual depreciation for prep aration of 50 kg of cookies incorporated with chicken meat mince (CMM) per day.

Sr. No.	Items	Particulars	Qty	Estimated cost (Rs)	Rate of depreciation (%)	Annual depreciation (Rs)
1	Weighing balance	10 Kg	1	2000	10	200
2	Oven for baking &drying	Big rotary type(20tray capacity)	1	15000	10	15000
3	Stainless steel patila	40 lit.	2	2000	10	200
4	Dough making machine	Big(25 Kg capacity)	1	25000	10	2500
5	Stainless steel cookies dropping Nossel	One set each	1	150	10	15
6	Baking trays (iron)	Big	50	2500	10	250
7	Stainless steel bucket	10 lit.	1	300	10	30
8	Chopping knives	-	2	200	10	20
9	Chopping board	-	1	100	10	10
10	Cookies dropping bag (cotton)	1kg capacity	2	200	20	40
11	Refrigerator	300 lit.	1	15000	10	1500
12	Deep freezer	110 lit.	1	25000	10	2500
13	Pressure cookers	20 lit.	2	4000	10	400
14	LPG connection	-	1	2500	10	250
15	Burner brass	-	2	800	10	80
16	Electronic lighter	-	1	50	10	5
17	Electric meat mincer	-	1	20000	10	2000
18	Stainless steel spoon	Big	2	150	10	15
19	Scaling machine	-	1	3500	10	350
20	Measuring vessels	1 lit.	2	100	10	10
21	Ceiling fan	-	1	1200	10	120
22	Miscellaneous items	-	-	1000	-	-
			Total	**253750**		**25395**

Table :8 Detailed breakup of the production cost of 50 kg cookies incorporated with chicken meat mince (CMM)

Sr. No.	Component	Rate (Rs)	Requirement (Kg./ annum)	Expenditure (Rs.Per annum)
A)	**Manufacturing cost**			
a)	**Direct product cost**			
I. Raw material				
1.	Refined wheat flour	20/kg	15,000 kg	3,00000
2.	Broiler meat (without deboning)	120 /kg	2723 kg	326760
3.	Deboned meat (55% of whole meat)	218 /kg	1500 kg	-
4.	Common salt	10/kg	225 kg	2250
5.	Sugar (powder)	35/kg	3750 kg	131250
6.	Spice mix	600/kg	90 kg	54000
7.	Shortening / Oil	100/kg	6000 kg	600000
8.	Milk (buffalo)	30/kg	3750 kg	102500
9.	Printed poly packs (capacity –200 g)	0.30/pack	30000 packs	9000
11.	Baking powder	100/kg	150 kg	15000
12	Vanilla essence	400/ ltr	120 ltr	48,000
13	Colouring agent	450/ kg	4.5 kg	20200
Subtotal (I)				
II. Operating labour and supervision				
1.	Supervisor	12,000/month	One	1,44,000
2.	Labour	6,000/month	Two	1,44,000
Sub-total (II)				
III. Power and utility				
1	Electricity power for drying chicken meat	6/KWH	10800 KWH	64800
2.	Electricity power (general)	5/KWH	900 KWH	5400
3.	Water	1/100 lit	2,50,000	2,500
(III)Sub-total				
IV	Maintenance/Laboratory charges	1000/month		12,000
V	Cleaning material (detergent)	20/kg.	300	6,000

VI	LPG Cylinder	1,300/19 kg	15x19 kg	19,500
Sub-total (a) = I+II+III+IV+V+VI) for CB				
b) Fixed charges				
1.	Rent for building	5,000/month		60,000
2.	Depreciation on capital investment (10%)			25395
3.	Insurance and taxes @ 2% of capital investment			5074
Sub-total (b)				**90469**
A)	**Sub-total A = a+b**			
B)	**General expenses** Interest on investment @ 12% per annum			
B) Product cost (A+B)				

Product	**Total cost (Rs./ Annum)**	**Total raw material (kg)**	**Yield (%)**	**Final product (kg)**	**Cost (Rs./ kg)**
CC Control cookies	1696043	33469.5	79.52	26615.23	**63.72**
CM10 Cookies with 10%CMM	1993043	33469.5	76.73	25681.14	**77.60**