J.Meat Sci., 2017, 12 (2) : 49 - 55

Research Paper

Development and Shelf Stability of Convenience and Ready to Eat Chicken Meat Powder Incorporated Cookies

Raj Kumar Berwal*, Nita Khanna[1] and Rekha Berwal[2]

Department of Livestock Products Technology, Rajasthan University of Veterinary and Animal Sciences, Bikaner-334001
[1] Department of Livestock Products Technology, Lala Lajpat Rai University of Veterinary & Animal Sciences, Hisar-125001
[2] Department of Home Science, C B R G Government Girls P.G. College, Sriganganagar 335001 (Rajasthan),

ABSTRACT

The study was conducted to develop cookies incorporated with chicken meat powder (CMP) at 10 to 50 per cent level. On the basis of sensory evaluation, the optimum level of CMP to be incorporated in cookies was selected. Of the various levels of CMP tried; the cookies with 40% CMP were preferred the most. The chicken meat powder incorporated cookies had better appearance, taste, texture, flavour and overall acceptability. It was concluded that the cookies with 40% chicken meat powder and 60% refined wheat flour are ready to eat food, would provide a nutritious diet and could be stored for 90 days at ambient temperature without any significant deterioration in microbiological quality and with acceptable sensory attributes.

Keywords : *Cookies, chicken meat powder, Refined wheat flour, Sensory evaluation, Shelf life*

Received : 17.05.2017 Accepted: 22.01.2018

INTRODUCTION

Convenience foods have played a vital role in the life of human beings since antiquity. The convenience products like breads, biscuits, cakes, chapattis and other ethnic foods are highly relished and have proven to be useful. 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 (Jorfi *et al.*, 2012) Children eat these baked products readily; mothers use them as pacifiers and sick people often relish biscuits and cookies rather than other foods

Meat incorporated foods are highly perishable so a preservation method such as dehydration can extend the shelf life of meat incorporated food products by lowering the water activity (a_w) to prevent microbiological deterioration. However, the sensory quality of meat products is adversely affected by dehydration to a moisture level <10 % (Kartz and Labuza, 1981). The palatability of dehydrated meat products can be improved by incorporation of other ingredients in the formulation and by appropriate process parameters. 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 (Singh *et al*., 2000; Gupta, 2001; Garg, 2001 and Lovis, 2003) in preparing and increasing the nutritive value of cookies have been documented.

MATERIALS AND METHODS

***Broiler chicken*:** Broiler birds of same age (six weeks) reared under similar feeding and management conditions were obtained from the Poultry Farm, College of Veterinary Sciences, Lala Lajpat Rai University of Veterinary and Animal Sciences (LUVAS), Hisar.

Ingredients: Different ingredients as given in table-1 were procured and used for the preparation of cookies.

***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.

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

*Corresponding author E-mail address: drberwalraj@gmailcom

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**

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^{0}C for further studies. The portion of frozen meat required for the experiment was taken out and kept at refrigeration temperature (4±1^{0}C) overnight for partial thawing and subsequently minced in a meat mincer and used.

***Preparation of chicken meat powder* (*CMP*):** The deboned frozen meat was minced in an electric meat mincer then thoroughly kneaded minced meat was placed in a pan and the minimum quantity of water was added to start the cooking. The traditional cooking was done for about 35 minutes till the meat was thoroughly browned as per recommendation of Bate-Smith *et al*. (1943). This precooked minced meat was dried in a cabinet tray drier at 60 ^{o}C for 9-10 hours and ground in an electric grinder (Inalsa) into a fine powder, packaged in low density polyethylene (LDPE) bags and stored at -20 ^{o}C for further use in cookies preparation.

Preparation of CMP incorporated cookies: Six types of cookies were prepared using different levels of refined wheat flour (RWF), chicken meat powder (CMP), 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 160^{o}C for 15-20 min or till golden brown, cooled and then packed in LDPE pouches.

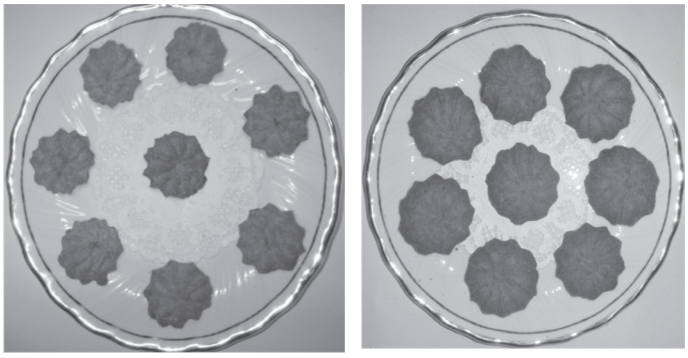
The pouches were sealed by using hand sealer model Pack Seal 1196 **(**Max Pack, Pune, India**)** and stored at an ambient 25±2^{o}C for up to 3 months and drawn periodically in 15 days intervals for quality evaluation**.**

Table 2: Formulation of cookies made with different levels of chicken meat

INGREDIENTS (g)	CC	CP10	CP 20	CP 30	CP 40	CP 50
	Control	10% CMP	20% CMP	30% CMP	40% CMP	50%CMP
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, CP = cookies made with chicken meat powder

Chicken Meat Powder (CMP) incorporated cookies



Control Cookies (CC) **Cookies with 40% CMP (CP40)**

Sensory evaluation:

The sensory quality attribute of CMP incorporated cookies were evaluated by semi trained panelists using 9- point hedonic scale.

Microbiological quality: The microbiological quality of the CMP incorporated cookies was assessed by enumerating standard plate count **(**SPC**)**, coli forms counts and yeast and mould counts using standard procedure of **(**APHA, 1984**).**

RESULTS AND DISCUSSION

Optimization of level of CMP in the developed cookies: Sensory scores of chicken incorporate cookies with different levels of chicken meat powder are presented in Table 3**.**

and 8.59 on incorporation of 40 per cent CMP, but there were a significant decrease in the crispness and taste scores on 50 per cent CMP incorporation and were found to be 7.86 and 7.67, respectively. Mean score of overall acceptability of cookies for control sample was 7.97 and was increased significantly on increased CMP incorporation and was 8.65 in cookies prepared with 40 per cent CMP incorporation level, but was decreased significantly to 7.43 in samples prepared with 50 per cent level of CMP. As the cookies having 40 per cent CMP showed higher scores amongst CMP incorporated cookies, it was selected for further studies.

There was significant increase in colour scores of cookies on incorporation of chicken meat powder (CMP) and was highest in cookies with 40% CMP level, that was 8.68, but on further incorporation of 50% CMP, a significant decrease was observed and the score was 7.90, which indicate that CMP can be incorporated up to 50%, but the optimally up to 40% level. Flavour or meat intensity score was increased on increase in level of CMP incorporation up to 50% .that was due to meaty flavour of CMP.

Crispness scores increased significantly from 20% to 40% CMP incorporation in cookies but decreased significantly at 50% CMP incorporation. This may be due to decreased binding property of chicken powder. Mackie (1994) reported that

Table 3: Sensory characteristics of cookies with different levels of chicken meat powder (CMP)

Sensory Parameter	Chicken meat powder (CMP) incorporated cookies					
	CC	CP 10	CP 20	CP 30	CP 40	CP 50
	Control	10%CMP	20%CMP	30%CMP	40%CMP	50%CMP
Colour and appearance	$8.22^{b} \pm 0.10$	$8.32^{b} \pm 0.11$	$8.33^{b} \pm 0.09$	$8.50^{ab} \pm 0.10$	$8.68^{a} \pm 0.08$	$7.90^{c} \pm 0.13$
Flavor	$7.56^{d} \pm 0.10$	$7.79^{cd} \pm 0.14$	$7.90^{bc} \pm 0.10$	$8.20^{b} \pm 0.11$	$8.73^{a} \pm 0.10$	$8.81^{a} \pm 0.08$
Texture / Crispness	$7.72^{c} \pm 0.14$	$7.76^{c} \pm 0.12$	$8.05^{b} \pm 0.15$	$8.00^{b} \pm 0.12$	$8.54^{a} \pm 0.11$	$7.86^{c} \pm 0.15$
Taste (Organoleptic)	$7.61^{c} \pm 0.10$	$7.74^{c} \pm 0.12$	$7.85^{c} \pm 0.13$	$8.25^{b} \pm 0.12$	$8.59^{a} \pm 0.09$	$7.67^{c} \pm 0.12$
Overall acceptability	$7.97^{c} \pm 0.08$	$8.21^{bc} \pm 0.14$	$8.32^{ab} \pm 0.11$	$8.38^{ab} \pm 0.10$	$8.65^{a} \pm 0.09$	$7.43^{d} \pm 0.11$

Mean ± S.E. with different small letter superscripts in a row within each parameter differ significantly (P d" 0.05); n =6; CC = control cookies, CP = cookies made with chicken meat powder

Colour and appearance score for control treatments was 8.22 which increased significantly to 8.68 in CP40. Further incorporation of CMP resulted in a significant decrease in colour and appearance scores.

Flavour scores were increased significantly with the increased level of CMP incorporation from 7.56 (control) to 8.81 (50 per cent CMP). Mean scores of crispness and taste for control cookies were increased significantly from 7.72 and 7.61 to 8.54

gelling functionality of meat proteins is generally reduced greatly after dehydration. There was increasing trend in taste scores upon up on increasing level of CMP incorporation up to 40% CMP, but taste scores were decreased significantly at 50% CMP incorporation. Overall acceptability scores of cookies significantly increased at 20% CMP level and highest (8.65) at 40% CMP level of incorporation, there after decreased significantly at 50% CMP level of incorporation. The cookies

(CP 40) having 40 per cent chicken meat powder showed higher scores amongst CMP incorporated cookies was selected for further studies.

***Quality changes in CMP incorporated cookies during storage*:** Proximate composition of selected cookies incorporated with chicken meat mince (CMP) is given in Table 4.

meat incorporation (Table 4) Crude protein content of chicken meat powder incorporated cookies was found significantly ($P < 0.05$) higher 31.51 per cent in cookies (CP40) with incorporation level of 40 per cent chicken meat powder. Similarly crude fat and ash content of control cookies was 22.52 per cent fat and 0.96 per cent ash, which increased significantly ($P < 0.05$) with an increase in level of CMP incorporation (Table 4.6). Crude fat content of cookies CP40

Table 4: Proximate composition (per cent) of chicken meat powder incorporated cookies.

	COOKIES			
	Moisture	**Crude protein**	**Crude fat**	**Ash**
CC	$3.12^{a} \pm 0.03$	$9.66^{b} \pm 0.04$	$22.52^{b} \pm 0.01$	$0.96^{b} \pm 0.04$
CP 4 0	$3.14^{a} \pm 0.04$	$31.51^{a} \pm 0.03$	$29.59^{a} \pm 0.02$	$1.74^{a} \pm 0.03$

Mean ± S.E. with different small letter superscripts in a column within each parameter differ significantly (P d" 0.05); n = 6, CC = control cookies, CP = cookies made with chicken meat powder

The moisture content of control cookies was 3.12 per cent which increased significantly ($P < 0.05$) with an increase in level of CMP incorporation (Table 5). Highest moisture content was observed in cookies developed using 40 per cent of chicken meat powder (CMP). Crude protein content of control cookies was found to be 9.66 per cent which increased significantly ($P < 0.05$) with an increase in level of chicken

was found 29.59 per cent. Ash content of cookies (CP40) was fond highest 1.74 per cent.

Values of chicken meat powder used in our study are near to values reported by Aslam *et al*. (2000) who had prepared chicken powder from broilers and stored up to 140 days at an ambient temperature and estimated chemical composition

Table 5: Effect of storage on organoleptic scores of chicken meat powder incorporated cookies during storage at ambient temperature (25 ± 2^{0}C)

Product	Days 0	15	30	45	60	75	90
				COLOUR AND APPEARANCE			
CC	$8.22^{aB} \pm 0.16$	$8.11^{aAB} \pm 0.11$	$8.02^{abB} \pm 0.08$	$7.94^{abcAB} \pm 0.10$	$7.78^{abcB} \pm 0.16$	$7.61^{bcB} \pm 0.16$	$7.56^{cB} \pm 0.17$
CP 40	$8.72^{aA} \pm 0.12$	$8.61^{aA} \pm 0.16$	$8.56^{aA} \pm 0.13$	$8.50^{aA} \pm 0.14$	$8.50^{aA} \pm 0.14$	$8.44^{aA} \pm 0.17$	$8.38^{Aa} \pm 0.16$
				FLAVOUR			
CC	$7.61^{aB} \pm 0.13$	$7.56^{aB} \pm 0.15$	$7.50^{aB} 0.16$	$7.44^{aB} \pm 0.17$	$7.39^{aB} \pm 0.16$	$7.33^{aB} \pm 0.16$	$7.22^{aB} \pm 0.22$
CP 40	$8.72^{aA} \pm 0.14$	$8.61^{aA} \pm 0.16$	$8.56^{aA} \pm 0.15$	$8.50^{aA} \pm 0.16$	$8.44^{aA} \pm 0.17$	$8.39^{aA} \pm 0.16$	$8.33^{aA} \pm 0.23$
				TEXTURE/ CRISPNESS			
CC	$7.83^{aB} \pm 0.20$	$7.78^{aB} \pm 0.22$	$7.72^{aB} \pm 0.22$	$7.67^{aB} \pm 0.23$	$7.56^{aB} \pm 0.17$	$7.50^{aB} \pm 0.16$	$7.44^{aB} \pm 0.17$
CP 40	$8.56^{aA} \pm 0.17$	$8.56^{aA} \pm 0.15$	$8.50^{aA} \pm 0.16$	$8.44^{aA} \pm 0.15$	$8.39^{aA} \pm 0.16$	$8.33^{aA} \pm 0.16$	$8.28^{aA} \pm 0.14$
				TASTE (Organoleptic)			
CC	$7.61^{aB} \pm 0.16$	$7.56^{aB} \pm 0.17$	$7.44^{aB} \pm 0.17$	$7.33^{aB} \pm 0.17$	$7.28^{aB} \pm 0.22$	$7.22^{aB} \pm 0.14$	$7.11^{aB} \pm 0.11$
CP 40	$8.56^{aA} \pm 0.17$	$8.56^{aA} \pm 0.15$	$8.50^{aA} \pm 0.16$	$8.44^{aA} \pm 0.15$	$8.39^{aA} \pm 0.16$	$8.33^{aA} \pm 0.16$	$8.28^{aA} \pm 0.14$
				OVERALL ACCEPTABILITY			
CC	$8.06^{aB} \pm 0.10$	$7.94^{aB} \pm 0.17$	$7.83^{aB} \pm 0.20$	$7.72^{aB} \pm 0.14$	$7.67^{aB} \pm 0.17$	$7.61^{aB} \pm 0.16$	$7.56^{aB} \pm 0.17$
CP 40	$8.89^{aA} \pm 0.07$	$8.78^{aA} \pm 0.14$	$8.67^{aA} \pm 0.17$	$8.61^{aA} \pm 0.14$	$8.56^{aA} \pm 0.15$	$8.56^{aA} \pm 0.15$	$8.50^{aA} \pm 0.17$

Mean ± S.E. with different capital letter superscripts in a column and small letter superscripts in a row within each parameter differ significantly (P d" 0.05); n = 6, CC = control cookies, CP = cookies made with chicken meat powder

having moisture 3.35-3.51%, protein 80.0-82.0%, fat 10.41-10.60% and ash 6.5-7.0%. The results were further confirmed by several researchers (Negrao *et al.* 2005; Kharb and Ahlawat, 2010; Thomas, 2011 and Sunil, 2012)

Microbiological status during storage at 25 ± 2^{0}C

Standard plate count: SPC followed a gradual increasing pattern from 0 to 30th day in control and CMP incorporated cookies but 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).

The low initial count might be due to thermal processing at higher temperature (baking at 160^{0}C**)** and low moisture content, hygienic practices during processing, storage and handling of the product as earlier reported (Grohs *et al.* 2000). Modi *et al*. (2007) reported similar results during storage of dehydrated chicken kebab mix and observed that dehydrated chicken kebab mix was microbiologically safe as indicated by very low initial bacterial counts and absence of coli forms throughout the storage period of 6 months.

The SPC values increased gradually by 75th day in both control and CMP incorporated cookies. This might be due to multiplication of microorganisms during storage (Bawa *et al.*, 1988). Similar increase in SPC on storage was reported by Nag . (1998) in chicken nuggets extended with rice. On day 90 of storage the TPC counts slightly decreased in cookies. This may be due to natural death of micro-organisms after certain period in adverse environmental conditions in the product.

Coli form counts: Coli forms were not detected in all CMP 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 at temperature (160^{0}C) above their thermal death point of 57^{0}C. Further, hygienic practices followed during and after preparation of the products could be one of the additional reasons for the absence of coli forms. Similar findings were also observed by Modi *et al*. (2007) in dehydrated chicken kebab mix during storage for 6 months.

Yeast and mould count: Yeast and mould growth was only detected after 60th day of storage and had very less growth (3 to 7 cfu/g) in CMP incorporated cookies throughout the storage period (Table 5).

Yeast and mould counts were found slightly higher in control (refined wheat flour) cookies than the CMP incorporated cookie during storage up to 90 days. This was 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 during storage had been reported by Modi *et al*. (2007) in dehydrated chicken kebab mix during storage at ambient temperature.

Sensory evaluation during storage at ambient temperature (25±2^{0}C).

Colour and appearance: 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, but the scores for colour and appearance were significantly higher in chicken incorporated cookies as compared to their control **(**Table 6**).**

This was 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 have been reported by Singh *et al*. (2002), Modi *et al*. (2007) in dehydrated chicken snacks and dehydrated chicken kebab mix, respectively. At the end of the storage, all the colour scores on control and chicken

Table 6: Standard plate count (cfu/g) of chicken meat powder incorporated cookies during storage at ambient temperature (25 ± 2^{0}C)

Product	0	15	30	45	60	75	90 Days
				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
CP40	ND	7±0.81	10±0.63	13±0.51	17±0.81	18±0.40	22± 0.40
				Yeast and mould count (cfu / g)			
CC	ND	ND	3± 0.81	7± 0.81	3± 0.51	5± 0.54	5± 0.83
CP40	ND	ND	ND	ND	5± 2.81	7± 0.81	5±0.83

Mean ± S.E. with different capital letter superscripts in a column and small letter superscripts in a row within each parameter differ significantly (P d" 0.05); n = 6, CC = control cookies, CP = cookies made with chicken meat powder

incorporated cookies were well within the acceptability range.

***Flavour /Meat flavour intensity*:** There was non significant decrease in the flavour scores of control as well as chicken meat powder incorporated cookies. The decreased flavour scores with the advancement in storage interval might be a multifactorial effect. That was 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 scores were significantly higher in cookies incorporated with 30% and 40% chicken meat powder as compared to control. The observation strongly agrees with the study of Singh *et al*. (2002), who observed that in chicken snacks with highest meat level, flavour scores were maximum.

Texture* / *Crispness: The texture / crispness of snacks is one of the most important characteristics affecting consumer acceptance**.** Matz **(**1993**)** noted that the texture of potato chips depending 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 crispiness scores of control and CMP 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.

REFERENCES

APHA (1984) Compendium of method for microbiological examination of food. 2nd Edn American Public Health Association

Bate-Smith EC, Lea, CH, Sharp, JD (1943) Dried Meat. J. Soc. Chem. Indus 62**(**7**):**1 00-104

Bawa, AS, Vineet, J, Thind, SS (1988) Effect of packaging and storage on the quality of chicken sausages containing soy flour. Indian J Meat Sci Technol 33**:** 42

Che Man, YB, Baker, J, Mokri, AAK (1995) Effect of packaging films on storage stability of intermediate deep fried mackerel. Int J Food Sci Technol 30**:** 175-179

Garg, R. (2001) Development of nutritional evaluation of some novel food products of wheat and legume blends. M.V.Sc. thesis, Haryana Agricultural University, Hisar, India

Grohs, BM, Kliegel, N, Kunz, B (2000) Bacteria grow slower: effects of spice mixtures on extension of shelf life of pork (Abstract). Fleischwirtschaft, 80**:** 61-63

Gupta, V (2001) Nutritional and sensory evaluation of value added bakery products, M.V.Sc. Thesis, CCS. HAU. Hisar, India

Jay, JM (1996) In: Modern Food Microbiology 4th edn. C.B.S. Publishers and Distributors, New Delhi

Jorfi, R, Mustafa, S, Che Man, YB, Mat Hashim, DB, Sazili, AQ, Farjam, AS, Nateghi, I, Kashiani, P (2012) Differentiation of por from beef, chicken, mutton and chevon according in their primary amino acids content for halal authentication. African Journal of Biotechnology 11(32)**:** 8160-8166

Kartz, EE. Labuza, TP (1981) Effect of water activity on the sensory crispiness and mechanical deformation of snack food products. J. Food Sci. 40**:** 403-409

Kharb, R, Ahlawat, SS (2010) Effect of pre cooking and spices on quality characteristics of dehydrated spent hen meat mince. Indian J Poult Sci 45**(**1**):** 100-102

Kumar, M, Sharma, BD (2004) Quality and storage stability of low-fat pork patties containing barley flour as fat substitute. J Food Sci Technol 41**(**5**):** 496-502

Lovis, LJ (2003) Alternatives to wheat flour in baked goods. Cereal Foods World 48**(**2**):**61-63

Mackie, IM (1994) Fish proteins. In: Hudson BJF, editor, New and Developing Sources of Food Proteins. London: Chapman & Hall, pp 95

Martz, SA (1993) Snack food Technology, 3rd ed.Van Nostrand Reinhold, New York

Modi, VK, Sachindra, NM, Nagegowda, P, Mahendrakar, NS, Narasimha Rao, D (2007) Quality changes during the storage of dehydrated chicken kebab mix. J. Food Sci. Technol 42**:** 827-835

Nagrao, CC, Mizubuti, IY, Morita, MC, Colli, C, Ida, EI, and Shimokomaki, M (2005) Biological evaluation of mechanically deboned chicken meat protein quality. Food Chemistry 90**:** 579-583

Nag, S, Sharma, BD, Kumar, S (1998) Quality attributes and shelf life of chicken nuggets extended with rice flour. Indian J Poult Sci 38**:** 182-186

Panda, PC (1995) Slaughtering techniques. In "Text book on egg and poultry technology". Vikas Publications, New Delhi, India

Singh, R, Singh, G, Chauhan, GS (2000) Nutritional evaluation of soy fortified biscuits. J Food Sci Technol 37: 162-164

Singh, VP, Sanyal, MK, Dubey, PC (2002) Quality of chicken snacks containing broiler spent hen meat, rice flour and sodium caseinate. J Food Sci Technol 39**(**4**):** 442-444

Suresh, D, Mendiratta, SK, Anajaneyulu, ASR (2003) Effect of calcium lactate on the quality and shelf life of restructured pork rolls. J Meat Sci 1: 1-6

Sunil (2012) Development and quality evaluation of instant idli mixes incorporated with chicken meat powder. M.V.Sc. Thesis, LLRUVAS, Hisar, Haryana, India.

Thomas, FG (2011) Improving the functional properties of dried meat proteins, M.Sc. Thesis, Food Science, North Carolina State University, Raleigh, North Carolina.