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RESEARCH PAPER

Development of Chicken Meat Cutlets Incorporating Carrots and Oats as Functional Ingredients

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Abstract

This study was conducted to evaluate the quality and shelf-life of chicken meat cutlets by incorporating functional ingredients like carrots and oats at optimized levels carrots (0, 5, 10, 15, 20% levels) and oats (0, 1, 2, 3, 4, 5% levels) in the products for their optimization in the formulation of chicken meat cutlets. On the basis of sensory evaluation, best levels of carrots (10%) and oats (5%) were incorporated in the chicken meat cutlets and stored under frozen conditions (-20± 2ºC) for two months after packaging in coextruded plastic film (conventional and vacuum packs) packs to evaluate shelf-life of the product. It was observed that functional chicken meat cutlets (carrots and oats) chicken meat cutlets had significantly ($p \leq 0.05$) higher moisture, cooking yield, color (L, a, b values) sensory attributes and lower ash, fat, protein, free fatty acids, peroxide values, lower shrinkage, shear force, pH and total viable count in comparison to control chicken meat cutlets. The chicken meat cutlets containing functional ingredients had significantly ($p \leq 0.05$) higher acceptability than control chicken meat cutlets. Vacuum packed chicken meat cutlets had significantly ($p \leq 0.05$) higher moisture, lower free fatty acid content, lower peroxide value and higher overall acceptability than conventionally packed chicken meat cutlets at the end of two months of frozen storage period (-20± 2ºC).

Keywords: Chicken meat cutlets, carrots, oats, shelf-life, total viable count

Meat and meat products are important component of human diet. Their major constituents are water, proteins and fats, with a substantial contribution of vitamins and minerals. It also supplies the essential amino acids which are required by the body for its proper function. Chicken meat is the most widely accepted meat in India. Unlike beef or pork; it does not have any religious taboo against its consumption. The price of chicken meat in India is also lower than that of mutton or goat meat. The forecast surveys indicate that as the present younger generation goes to the adulthood, the acceptability and demand for eggs and chicken meat in next 2-3 decades is likely to increase many-folds. Majority of frozen meat products sold in the Indian market are chicken meat based.

There has been a dramatic shift in consumer eating habits in favour of chicken meat over other red meats in the recent years. As consumers are getting more health conscious and chicken meat products containing health promoting functional ingredients with lower fat, salt, cholesterol, calorific contents, without chemical preservatives and synthetic food additives are much sought after. As interest in the link between diet and health gathers momentum, many consumers seek ways to feel well and stay healthy by eating nutritionally designed foods.

A food can be regarded as functional if it is satisfactorily demonstrated to beneficially affect one or more target functions in the body, beyond adequate nutritional effects, in a way that is relevant to either improved health or well-being and or to a reduction in the risk of disease (Fernandez- Gines *et al.,* 2005). Incorporation of functional ingredients in the recipes of the meat products is one approach for the development of functional meat products. Such ingredients include vegetable, fiber, antioxidants, probiotics and prebiotics. In fact, dietary fibers from oats, sugarbeet, soybeans, apple, peas and probiotic lactic acid bacteria have been used in the formulation of meat products (Fernandez-Gines *et al.,* 2005; Jimenez-Colmenero *et al.*, 2006).

Carrots (*Daucus carota* L.) are valuable for their taste, good digestibility and high content of provitamin A i.e. carotenoids and fibre. Both the epidemiological and nutritional studies have pointed out its positive impact on human health. The alpha and beta carotenes found in carrots roots acts as natural antioxidants. Beta carotene also prevents the appearance or impedes the development of cancerous cells. It is also found to have anti mutagenic, anti-tumoral, immuno-stimulant and antiulceric properties which are beneficial for human vision, skin, teeth and gums.

Oats are also being increasingly used as a functional ingredient in foods. Oats (*Avena sativa*) is a cereal containing β-glucans, which have an effect on lowering blood serum cholesterol levels and control of lipoprotein metabolism. It has been extensively reported that daily dietary fibre intake helps in prevention of many nutritional disorders like gut related problems, cardiovascular diseases, type 2 diabetes, certain types of cancer and obesity. Meat is generally lacking in such potential ingredient, which could be incorporated during processing of comminuted products to make them more healthful (Verma and Banerjee 2010). Meat and meat products can be modified by adding ingredients considered beneficial for health or by eliminating or reducing components that are considered harmful for the human body.

The objectives of this study were to optimize the level of incorporation of functional ingredients (carrots and oats) in chicken meat cutlets. Evaluation of the physico-chemical, functional and organoleptic quality of the chicken meat cutlets containing optimized levels of carrots and oats as functional ingredients and assess the effect of incorporation of functional ingredients carrots and oats on the shelf-life of frozen chicken meat cutlets, packed conventionally and under vacuum.

MATERIALS AND METHODS

Raw materials

Chicken meat

Frozen minced chicken meat was purchased from local White Pearl, Bromark outlet in Ludhiana of 250 g units each and stored at -20±2°C in a deep freezer, till its use in the preparation of chicken meat cutlets. The chicken meat was tempered and thawed using microwave oven (Batliboi Eddy Co. Model No. ER-5054 D) for 2 minutes at power level 4, before its use in the production of chicken meat cutlets.

Carrots

The carrots were purchased from the local market. They were boiled in water and crushed in food processor to form paste (Kenstar Karishma Multi Processor, Model no. MF0808) before its incorporation into the batter for the preparation of chicken meat cutlets.

Oats

Oats flakes of Saffola brand 200 g, packages were procured from the local market. Oats were added as such into the batter for the preparation of chicken meat cutlets.

Standardization of product formulation

The recipe of chicken meat cutlets was standardized by consulting literature and by taking the opinion of taste panel members during product standardization. Trials were conducted using different levels of salt and spices for the standardization of the recipe. The standardized recipe of chicken meat cutlets is given in Table 1. After standardization of the recipe, trials were conducted incorporating carrots (0, 5, 10, 15 and 20% levels), and oats (0, 1, 2, 3, 4 and 5% levels) in the raw mixture for their optimization in the formulation of chicken meat cutlets. On the basis of sensory evaluation results, best levels of carrots (10%) and oats (5%) were selected for their incorporation in the batter for final product preparation i.e. chicken meat cutlets. The chicken meat cutlets were used for the analysis of proximate composition, cooking characteristics, organoleptic and microbiological quality at an intervals of 15 days upto 2 months of frozen storage.

Table 1: Recipe for the preparation of chicken meat cutlets

Ingredients	Quantity (grams)
Chicken meat mince	1000
Carrots	100
Oats	50
Refined groundnut oil	120
Salt	18
Dry spice mix	15
Onion paste	25
Ginger paste	12.5
Garlic paste	12.5
Chilled water	60
Sodium nitrate	0.6
Sodium nitrite	0.3
Sodium alginate	20
Calcium carbonate	6
Bread crumbs (For battering)	2
Boiled potato	100
Peas	75
Coriander leaves	50

Preparation of cutlets

The chicken meat mince, salt and sodium nitrite were mixed in Hobart mixer Model N-50 for five minutes. Carrots (10%) and oats (5%) were added followed by dry spice mix and other additives as per the formulation to form uniform batter. After uniform mixing of all the ingredients, the batter was molded into cutlets with the help of oval shaped metallic moulds 10 cm long and 6.5 cm maximum width placed in steel trays. The cutlets (approximately 80gm each) were precooked in hot air oven at 200°C for 12 minutes. The pre-cooked cutlets were cooled, removed from the moulds coated with bread crumbs and packed conventionally using heat sealer (Ambala Associates) and under vacuum using vacuum packaging machine (Teknik Industrial Traders, Ambala city Model D2Q400-2D) in co-extruded plastic film bags. The packed cutlets were frozen stored at (-20± 2°C) in commercial freezer upto two months.

Storage studies

Chicken meat cutlets were prepared and packed in co- extruded plastic film bags (200 guage) by conventional and vacuum packaging for chicken meat cutlets. Chicken meat cutlets were frozen stored at (-20± 2°C). The physico chemical tests like moisture content, protein content, free fatty acid content, peroxide value and sensory acceptability were analyzed for two months frozen storage period at 15 days intervals.

Physico-chemical analysis

Minced sample (10g) was dried in a clean, dry and pre-weighed moisture dish and kept in with lid removed at 100- 105°C for 16-18 hours. After cooling in desiccators, loss in weight was calculated as moisture of sample and expressed as per cent moisture.

$$\text{Moisture content (\%)} = \frac{\text{Weight of fresh sample (g)} - \text{Weight of dried sample}}{\text{Weight of fresh sample (g)}} \times 100$$

Macro Kjeldahl method was used for the determination of protein (AOAC, 2000). The per cent nitrogen was converted into per cent protein as:

$$\% \text{ Protein} = \% \text{ Nitrogen} \times 6.25$$

Crude fat was extracted from dried sample using Soxhlet apparatus using standard AOAC (2000) and expressed as:

$$\text{Fat (\%)} = \frac{\text{Weight of fat (g)}}{\text{Weight of fresh sample (g)}} \times 100$$

Ash content was determined by placing the charred samples in silica dishes and heated in muffle furnace at 525°C for 6 hrs until white color ash was obtained to a constant weight (AOAC, 2000).

$$\text{Ash (\%)} = \frac{\text{Weight of reduce (g)}}{\text{Weight of sample (g)}} \times 100$$

Standard AOAC (2000) procedure was followed to determine peroxide value of samples. 30 ml of acetic acid: chloroform (2:1) was added to the weighed sample. The blank was run side-by-side. Peroxide value was determined by following formula:

Peroxide value (meq/kg) =

$$\frac{(\text{Sample reading} - \text{Blank reading}) \times \text{Normality of } Na_2S_2O_3}{\text{Weight of sample (g)}} \times 1000$$

Standard AOAC (2000) procedure was followed and the acid value was determined using formula:

$$\text{Acid value} = \frac{\text{ml of alkali} \times \text{Normality of alkali} \times 56.1}{\text{Weight of sample (g)}}$$

$$\%\ \text{FFA} = \text{Acid value} / 1.99$$

pH of chicken meat cutlets was determined using Max digital pH meter.

The color of chicken meat cutlets (*L*, *a* and *b*) was determined by using Hunter color lab.

The hardness of chicken products i.e. patties was analyzed by Stable Microsystem Texture Analyser Model (TA-H di England) using settings pre test speed 1.00mm/sec, test speed and post test speed 5.00mm/sec and trigger force of 5g was used. The texture analyzer has two basic components hardware (load cell with sample platform to hold the sample and a moving head for holding the probe) and the software (Texture expert) for recording and interpreting the results for the particular texture parameter. Before the test was conducted on the sample, the machine was calibrated for load and distance.

After calibrating the machine, the sample was placed on the sample platform and the command 'RUN TEST' was given .75mm cylindrical probe was used for cutlets. Compression force was evaluated to judge the hardness of the products.

Cooking characteristics

Cooking yield

Percent cooking yield was determined by calculating weight difference between the raw and cooked chicken meat cutlets before and after cooking.

$$\text{Cooking yield (\%)} = \frac{\text{Cooked product weight (g)}}{\text{Raw product weight (g)}} \times 100$$

Shrinkage

The average length of raw and cooked cutlets was calculated after measuring length at two different locations using a vernier caliper. Per cent change in length indicating the shrinkage was determined as given below:-

$$\text{Shrinkage (\%)} = \frac{\text{Raw cutlet length} - \text{Cooked cutlet length}}{\text{Raw cutlet length}} \times 100$$

Microbiological quality

Total viable count of chicken meat cutlets was expressed as:

TVC/ g = Mean colony count × dilution factor

Statistical analysis

The data on the proximate composition, cooking characteristics, microbial quality and organoleptic scores of fresh and frozen products were statistically analyzed and subjected to analysis of variance using completely randomized design (CRD) using the software CPCS-1 (Singh *et al.,* 1991). Each value is a mean of three observations.

RESULTS AND DISCUSSION

Physico-chemical characteristic

The average moisture content of fresh cooked chicken meat cutlets containing carrots and oats was found to be higher than the control as given in the Fig. 1. The loss in moisture was higher (p≤ 0.05) in conventionally packed than vacuum packed chicken meat cutlets. The lowering of moisture content might be due to denaturation of chicken meat proteins during frozen storage and cooking, resulting in lowering of water holding capacity (Addis 1986; Foegeding *et al.,* 1996). Martino and Zaritzky (1988) have reported that the size of ice crystal in frozen beef increased with time when stored under constant frozen temperature which resulted in moisture loss during cooking.

The average protein content (Fig. 2) of cooked, functional chicken meat cutlets containing carrots and oats increased significantly (p≤0.05) at the end of two months but the increase was non-significant (p≤0.05) with respect to treatment, packaging method and frozen storage periods. The increase in protein content was higher in conventionally packed than vacuum packed chicken meat cutlets. The increase in the protein content could be due to moisture loss during frozen storage period.

The average crude fat content of cooked, functional chicken meat cutlets containing carrots and oats increased significantly (p≤0.05) at the end of two months but the increase was non-significant (p≤0.05) between subsequent intervals of 15 days with respect to treatment, packaging and frozen storage periods (Fig 3). The fat content was higher in conventionally

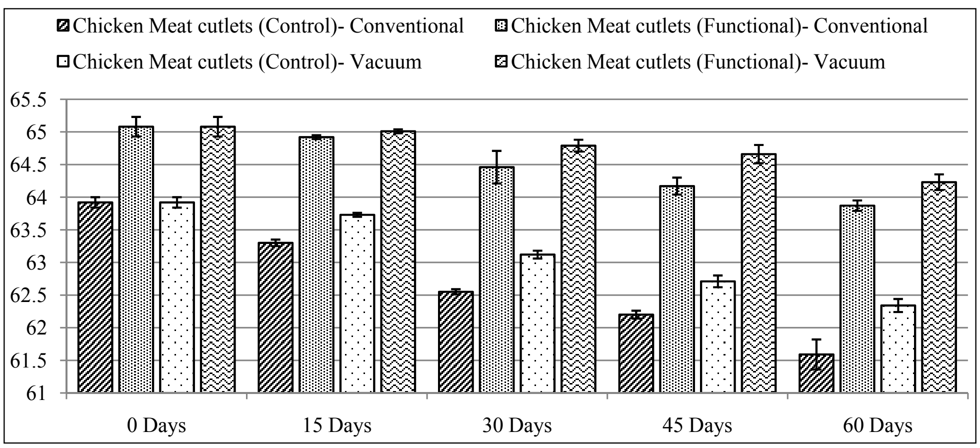

Fig. 1: Effect of storage period and packaging methods on moisture (%) of raw chicken meat cutlets

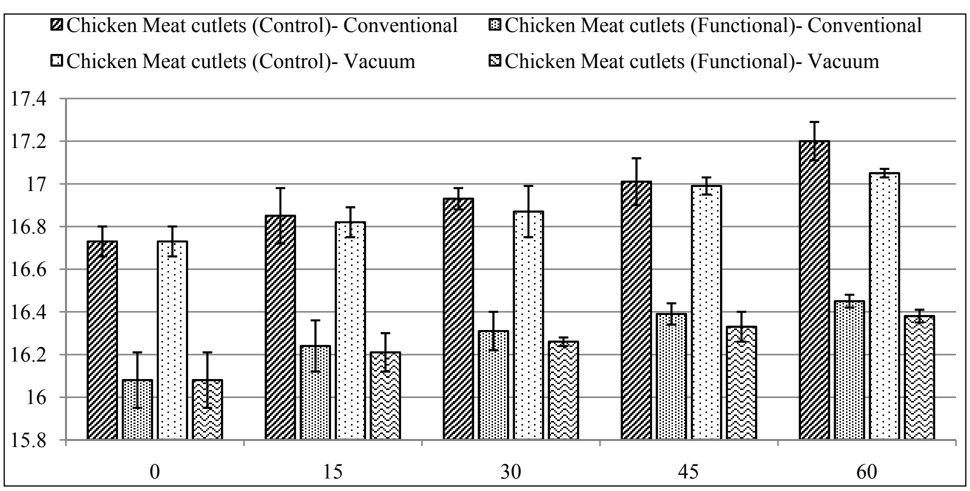

Fig. 2: Effect of storage period and packaging methods on protein (%) of cooked chicken meat cutlets

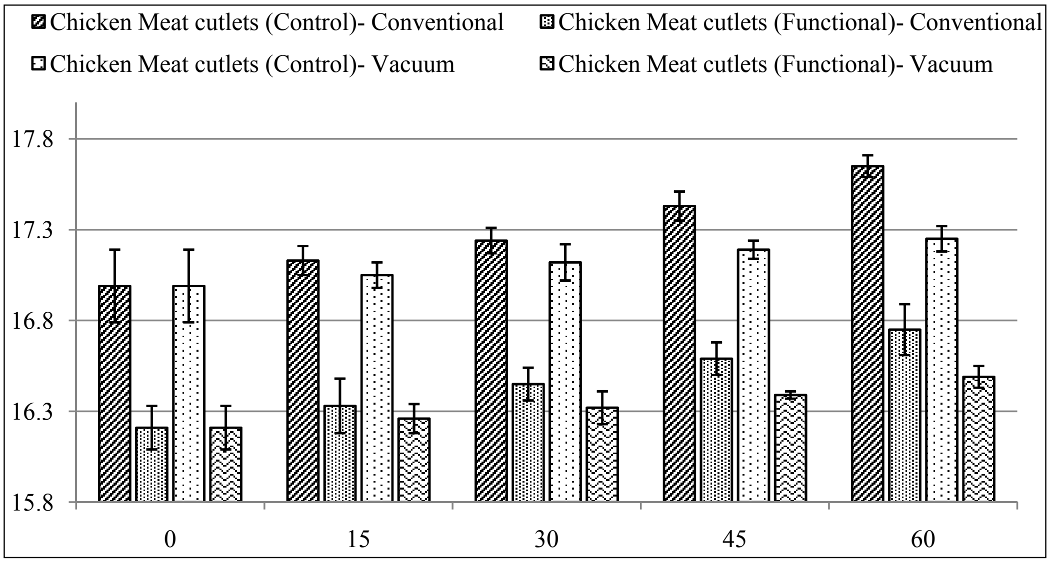

Fig. 3: Effect of storage period and packaging methods on fat (%) of cooked chicken meat cutlets

packed cooked chicken meat cutlets than vacuum packed chicken meat cutlets. The increase of fat content in chicken meat cutlets with increase in frozen storage period could be due to decrease in moisture content of the cooked chicken meat cutlets with increase in frozen storage time and higher fat retention Kashyap *et al.* (2012).

Ash content

The average ash content (Fig. 4) of cooked, functional chicken meat cutlets containing carrots and oats increased significantly ($p \leq 0.05$) but the increase was non-significant ($p \leq 0.05$) with respect to treatment, packaging and frozen storage periods between intervals of 15 days. The ash content was higher in conventionally packed cooked chicken meat cutlets than vacuum packed chicken meat cutlets. The incorporation of carrots and oats in chicken meat cutlets non-significantly decreased the ash content of the chicken meat cutlets as compared to control. According to Thind *et al.* (2006) the increase in ash content might be attributed to the decrease of moisture content of cooked chicken meat patties with increase in frozen storage period.

Changes in Peroxide value and Free Fatty Acids

Free fatty acids (Fig. 5) are the products of enzymatic or microbial degradation of lipids. Determination of FFA content gives information about stability of fat during storage. The average free fatty acid content of cooked functional chicken meat cutlets containing carrots and oats increased significantly ($p \leq 0.05$) but the increase was non-significant ($p \leq 0.05$) between subsequent intervals of 15 days frozen storage, packaging and treatment. There was higher development of free fatty acids in conventionally packed than vacuum packed chicken meat cutlets. The non-significant increase in free fatty acid value of vacuum packed chicken meat cutlets during frozen storage could be due to the absence of oxygen in vacuum packs. Modi *et al.* (2007) reported similar trend but higher value of free fatty acid in freshly prepared dehydrated chicken kabab mix with free fatty acid values of 0.99 ± 0.205, which gradually ($p \leq 0.05$) increased to 1.74 ± 0.073, during 6 months of storage.

Peroxide value

The primary products of lipid oxidation are hydro peroxides; therefore it seemed reasonable to determine the concentration of peroxides in the chicken meat cutlet samples to study the extent of oxidation. Peroxide values were used as an indicator to assess the level of lipid oxidation in cooked chicken

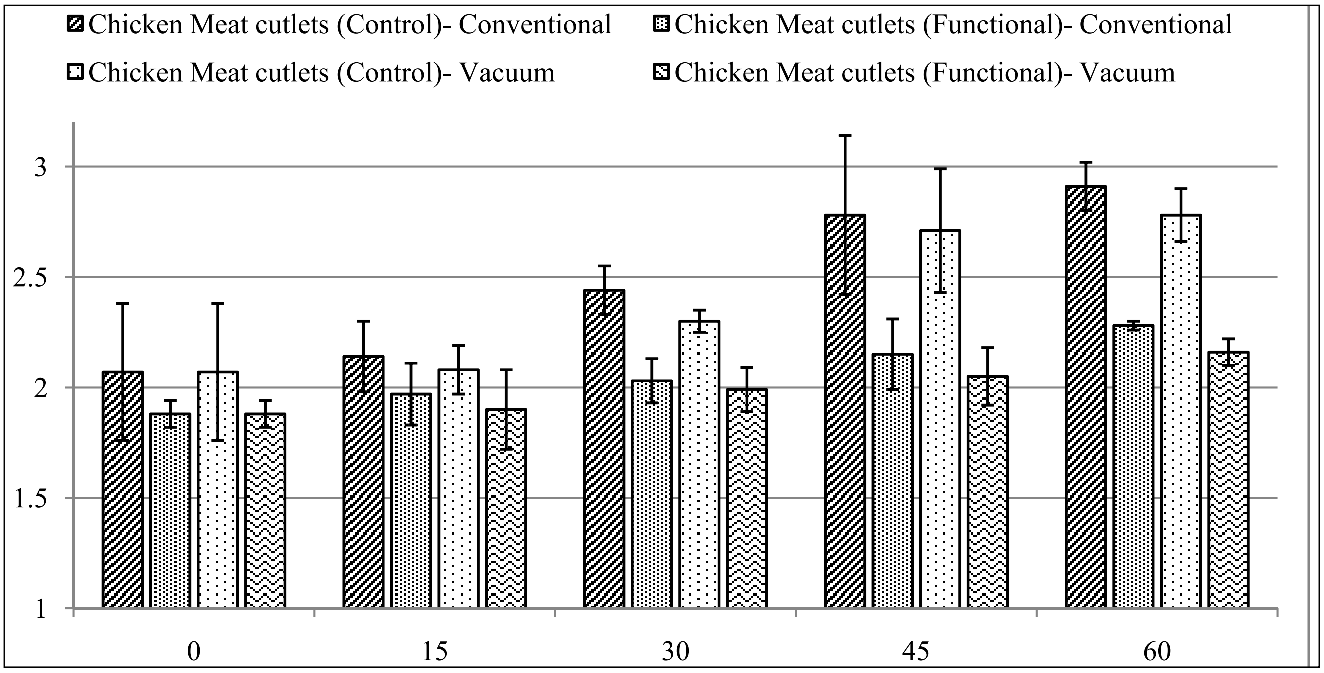

Fig. 4: Effect of storage period and packaging methods on ash (%) of cooked chicken meat cutlets

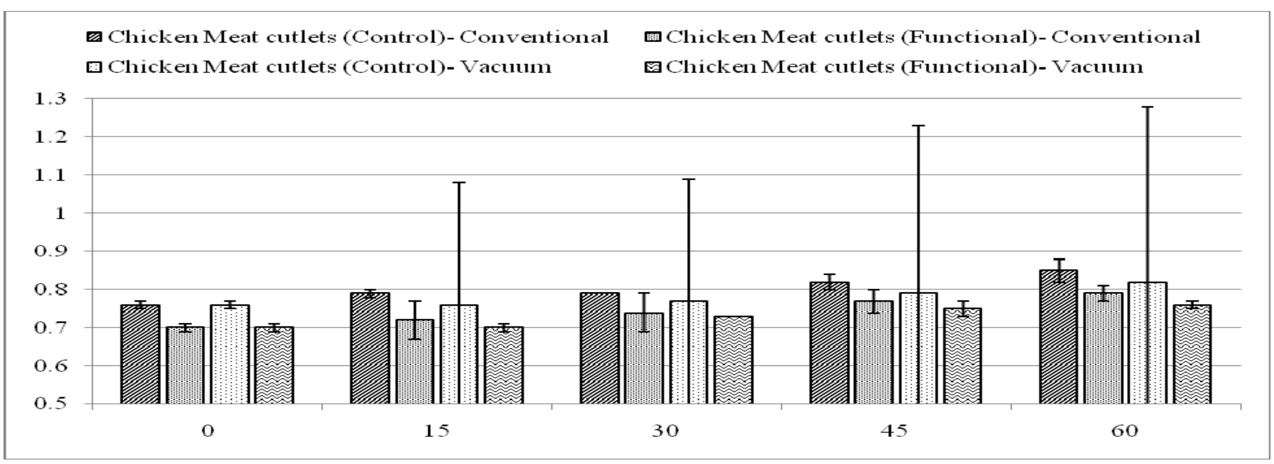

Fig. 5: Effect of storage period and packaging methods on free fatty acid content of cooked chicken meat cutlets

meat cutlets during frozen storage (-20±2^{0}C). The average peroxide value (Fig. 6) of cooked chicken meat cutlets increased significantly (p≤0.05) in functional chicken meat cutlets after two months of frozen storage period. There was higher increase in the peroxide value in case of conventionally packed chicken meat cutlets than vacuum packed chicken meat cutlets.

The significant (p≤0.05) increase in peroxide value in conventionally packed control chicken meat cutlets during frozen storage might be due to catalysis of intercellular compounds after destruction of the cells by NaCl and processing Juntachote *et al.* (2006). The peroxidation of lipids could have been facilitated by oxygen availability during storage which might be the reason for lower peroxide value in vacuum packed chicken meat cutlets. All samples had significantly (P< 0.05) lower peroxide value as compared to control. The addition of carrots and oats in chicken meat cutlets might have decreased the lipid peroxidation as measured by decrease in peroxide value, probably because of the carotenoids which function as antioxidants by terminating free radical chain reaction.

Cooking characteristics of chicken meat cutlets

Cooking yield

The average cooking yield (Table 2) decreased significantly in cooked chicken meat cutlets containing

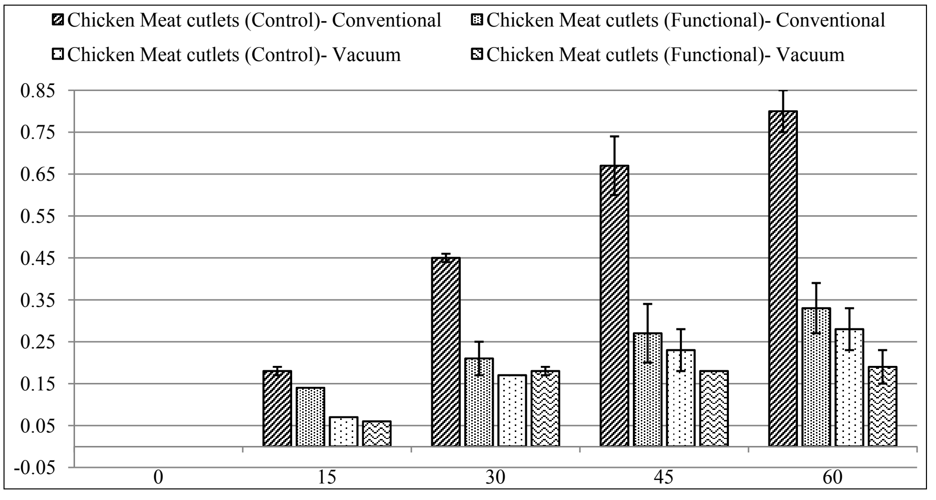

Fig. 6: Effect of storage period and packaging methods on peroxide value (meq/Kg) of cooked chicken meat cutlets

Table 2: Effect of storage on cooking yield (%) of cooked chicken meat cutlets (n=3)

Storage Period (Days)	Conventional Packaging		Vacuum packaging	
	Control	Functional cutlets	Control	Functional cutlets
0	86.20±0.14	89.71±0.04	86.20±0.14	89.71±0.04
15	85.75±0.54	89.45±0.07	85.99±0.84	89.60±0.04
30	85.28±1.37	89.14±0.50	85.52±0.15	89.25±0.54
45	84.75±0.29	88.88±0.46	85.28±0.25	89.03±0.41
60	83.99±0.18	88.45±0.27	84.98±0.15	88.91±0.09

C.D. (p≤0.05)
Treatment: NS Packaging: 0.239 Storage: 0.378
Treatment × Packaging: NS Treatment × Storage: NS Packaging × Storage: 0.535
Treatment × Packaging × Storage: NS
* C.D. = Critical Difference; ** NS = Non-significant; *** ± = Standard Deviation

carrots and oats with respect to packaging and frozen storage. There was significant decrease (p≤ 0.05) in the cooking yield at the end of two months frozen storage.

Shrinkage

The average shrinkage (Table 3) of cooked and conventionally packed, functional chicken meat cutlets containing carrots and oats increased significantly (p≤0.05) from 4.65 to 5.45% but the increase was non-significant (p≤0.05) with respect to treatment, packaging method and frozen storage periods. The average shrinkage of vacuum packed, cooked chicken meat cutlets increased significantly (p≤0.05) from 4.65 to 5.29% in functional chicken meat cutlets containing carrots and oats but the increase was non-significant (p≤0.05) with respect to treatment, packaging method and frozen storage period. The shrinkage was significantly (p≤0.05) higher in conventionally packed cooked chicken meat cutlets than vacuum packed chicken meat cutlets.

pH

The average pH (Fig. 7) of fresh, cooked, conventionally packed functional chicken meat cutlets containing carrots and oats increased significantly (p≤0.05) from 6.62 to 6.83 but the increase was non-significant (p≤0.05) with respect

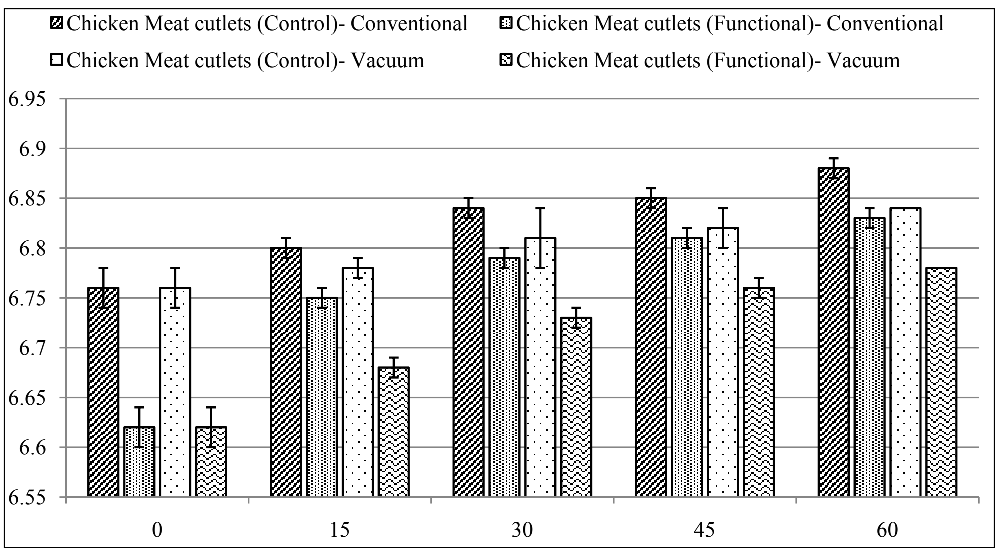

Fig. 7: Effect of storage period and packaging methods on the pH of cooked chicken meat cutlets

Table 3: Effect of storage period and packaging methods on Shrinkage (%) of cooked chicken meat cutlets (n=3)

Storage Period (Days)	Conventional Packaging		Vacuum packaging	
	Control	**Functional cutlets**	**Control**	**Functional cutlets**
0	5.51±0.70	4.65±0.00	5.51±0.70	4.65±0.00
15	5.91±0.03	4.68±0.02	5.53±0.71	4.67±0.02
30	6.26±0.22	5.09±0.03	6.17±0.31	4.88±0.30
45	6.63±0.36	5.27±0.13	6.26±0.14	5.06±0.06
60	6.70±0.08	5.45±0.22	6.43±0.25	5.29±0.00

C.D. (p≤0.05)

Treatment: 0.167 Packaging: 0.167 Storage: NS

Treatment × Packaging: NS Treatment × Storage: NS Packaging × Storage: NS

Treatment × Packaging × Storage: NS

to treatment, packaging method and frozen storage periods. The average pH of vacuum packed cooked chicken meat cutlets increased significantly (p≤0.05) from 6.62 to 6.78 in functional chicken meat cutlets after two months of frozen storage period. The results were non-significant (p≤0.05) with respect to treatment, packaging and frozen storage periods.

Texture

The average force required to compress fresh conventionally packed chicken meat cutlets was significantly (p≤0.05) higher than that for vacuum packed control and functional chicken meat cutlets (Table 4). The lower hardness of functional chicken meat cutlets as compared to control might be due to their lower lean meat content resulting in the weaker protein binding and gelation in denatured protein matrix. The average force required to compress fresh conventionally packed chicken meat cutlets was significantly (p≤0.05) higher than that for vacuum packed control and functional chicken meat cutlets.

Total viable count

The TVC of uncooked control (Fig. 8) as well as functional chicken meat cutlets containing carrots and oats, conventionally and vacuum packed were conducted after every 15 days intervals upto two months of frozen storage period. The average TVC of vacuum packed control chicken meat cutlets decreased significantly (p≤0.05) from 4.93 to 4.70 log

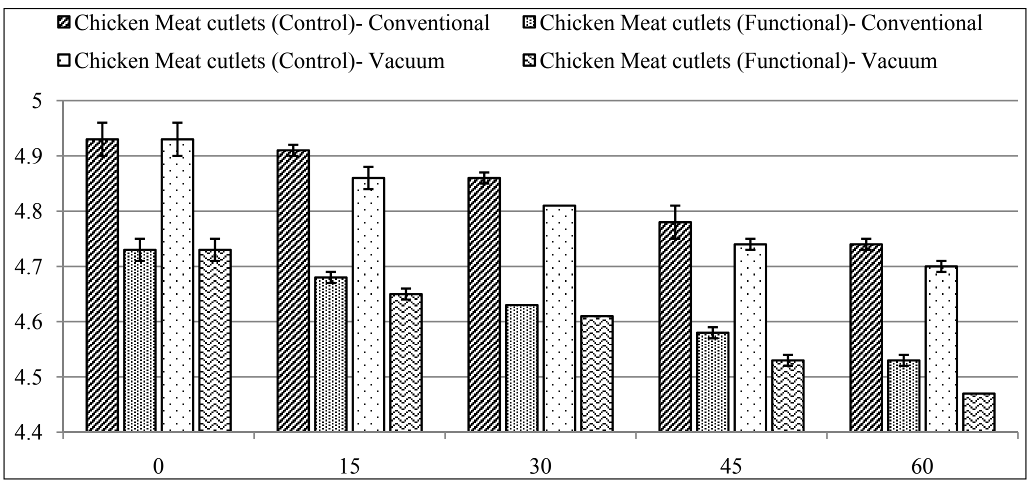

Fig. 8: Effect of storage period and packaging methods on the TVC (log cfu/gm) of raw chicken meat cutlets

Table 4: Effect of storage period and packaging methods on the Hardness (kg/cm^2) of Cooked chicken meat cutlets (n=3)

Storage Period (Days)	Conventional Packaging		Vacuum packaging	
	Control	Functional cutlets	Control	Functional cutlets
0	7.71±0.11	6.41±0.06	7.71±0.11	6.41±0.06
15	7.84±0.15	6.50±0.15	7.79±0.08	6.44±0.08
30	7.97±0.15	6.65±0.19	7.91±0.19	6.55±0.06
45	8.25±0.10	6.81±0.10	8.16±0.08	6.60±0.07
60	8.41±0.13	6.99±0.13	8.30±0.17	6.75±0.13

C.D. (p≤0.05)
Treatment: 0.064 Packaging: 0.064 Storage: 0.102
Treatment × Packaging: NS Treatment × Storage: 0.020 Packaging × Storage: NS
Treatment × Packaging × Storage: NS

cfu/gm and the average TVC of functional chicken meat cutlets decreased significantly (p≤0.05) from 4.73 to 4.47 log cfu/gm at the end of two months of frozen storage (-20±2ºC) period. The results were non-significant (p≤0.05) with respect to treatment, packaging and frozen storage period. The reduction in microbial load might be due to the destructive effect of freezing on bacteria.

Color

The 'L' value is the measure of the lightness (Table 5). The maximum value for the 'L' value is 100 which indicate whiteness and the minimum value is 0 which indicates black. The 'L' value was higher in functional chicken meat cutlets in comparison to control. There was significant increase (p≤0.05) in the 'L' value in both type of packaging material used but the increase was more in conventionally packed chicken meat cutlets than the vacuum packed chicken meat cutlets. This could be due to the more oxidation of the color giving pigments in case of the conventionally packed chicken meat cutlets than vacuum packed chicken meat cutlets. Gok *et al.* (2008) studied the effect of the packaging and storage time on the sensory, microbiological and chemical properties of the Turkish pastirma for 120 days and found that there was higher increase in the 'L' value with time in aerobic packaging as compared to vacuum packaging.

The 'a' value is the measure of the redness (Table 6). The positive value for 'a' value indicates redness and the negative value indicates greenness. There was significant (p≤0.05) decrease in 'a' value in both conventionally and vacuum packed chicken

Table 5: Effect of storage period and packaging methods on the 'L' value of raw chicken meat cutlets (n=3)

Storage Period (Days)	Conventional Packaging		Vacuum packaging	
	Control	Functional cutlets	Control	Functional cutlets
0	42.23±0.29	43.97±0.03	42.23±0.29	43.97±0.03
15	43.53±0.48	44.81±0.25	43.19±0.49	44.72±0.41
30	45.63±0.13	45.24±0.13	43.54±0.34	44.93±0.05
45	45.92±0.07	45.78±0.15	43.98±0.13	45.24±0.10
60	47.06±0.06	46.08±0.08	44.95±0.08	45.44±0.05

C.D. (p≤0.05)
Treatment: 0.123 Packaging: 0.123 Storage: 0.195
Treatment × Packaging: 0.175 Treatment × Storage: 0.277 Packaging × Storage: 0.277
Treatment × Packaging × Storage: 0.391

Table 6: Effect of storage period and packaging methods on the 'a' value of raw chicken meat cutlets (n=3)

Storage Period (Days)	Conventional Packaging		Vacuum packaging	
	Control	Functional cutlets	Control	Functional cutlets
0	1.37±0.07	3.64±0.06	1.37±0.07	3.64±0.06
15	1.17±0.07	3.44±0.04	1.30±0.01	3.55±0.04
30	0.98±0.02	3.07±0.06	1.15±0.06	3.25±0.07
45	0.60±0.05	2.76±0.07	0.98±0.03	2.93±0.07
60	0.48±0.03	2.52±0.02	0.85±0.02	2.77±0.03

C.D. (p≤0.05)
Treatment: 0.028 Packaging: 0.028 Storage: 0.044
Treatment × Packaging: 0.039 Treatment × Storage: 0.062 Packaging × Storage: 0.062
Treatment × Packaging × Storage: NS

meat cutlet but there was steeper decrease in the conventionally packed chicken meat cutlets than the vacuum packed chicken meat cutlets. This could be due to the more oxidation of the beta carotene pigments in case of the conventionally packed chicken meat cutlets than vacuum packed chicken meat cutlets. Higher 'a' value for functional chicken meat cutlets indicated that they were redder than the control.

The 'b' value is the measure of the yellowness (Table 7). The positive value for the 'b' value indicates yellowness and the negative value indicates blueness. There was significant ($p \leq 0.05$) decrease in the 'b' value of cutlets packed by both of packaging methods but there was steeper decrease in the conventionally packed chicken meat cutlets than the vacuum packed chicken meat cutlets. This could be due to the more oxidation of the pigments in case of the conventionally packed chicken meat cutlets than vacuum packed.

CONCLUSION

Based on results of this study, it was concluded that good quality chicken meat cutlets could be prepared after incorporation of carrots (10%) and oats (5%). The sensory quality of the chicken meat

Table 7: Effect of storage period and packaging methods on the 'b' value of raw chicken meat cutlets (n=3)

Storage Period (Days)	Conventional Packaging		Vacuum packaging	
	Control	Functional cutlets	Control	Functional cutlets
0	5.35±0.14	9.62±0.07	5.35±0.14	9.62±0.07
15	5.20±0.10	9.31±0.03	5.31±0.02	9.45±0.06
30	4.98±0.03	8.79±0.22	5.15±0.03	9.21±0.09
45	4.78±0.03	7.98±0.13	4.99±0.04	8.79±0.10
60	4.53±0.01	7.63±0.02	4.78±0.02	8.56±0.03

C.D. ($p \leq 0.05$)
Treatment: 0.047 Packaging: 0.047 Storage: 0.074
Treatment × Packaging: 0.066 Treatment × Storage: 0.105 Packaging × Storage: 0.105
Treatment × Packaging × Storage: 0.149

Table 8: Effect of storage period and packaging methods on the Beta- Carotene of cooked chicken meat cutlets (n=3)

Storage Period (Days)	Conventional Packaging		Vacuum packaging	
	Control	Functional cutlets	Control	Functional cutlets
0	N.D	6.12±0.35	N.D	6.12±0.35
15	N.D	5.87±0.02	N.D	6.06±0.05
30	N.D	5.67±0.02	N.D	5.91±0.04
45	N.D	5.48±0.03	N.D	5.74±0.03
60	N.D	5.34±0.03	N.D	5.63±0.03

Mean± SD
C.D. ($p \leq 0.05$)
Treatment: 0.059 Packaging: 0.059 Storage: 0.094
Treatment × Packaging: 0.084 Treatment × Storage: NS Packaging × Storage: 0.133
Treatment × Packaging × Storage: NS
* N.D- Not detected

Table 9: Effect of storage period and packaging methods on the Sensory evaluation of cooked chicken meat cutlets (n=3)

Day	Appearance				Flavor				Texture				Overall acceptability			
	Conventional Packing		Vacuum Packaging		Conventional Packing		Vacuum Packaging		Conventional Packing		Vacuum Packaging		Conven-tional Packing	Vacuum Packag-ing	Conven-tional Packing	Vacuum Packag-ing
	Con*	**Func****	**Con***	**Func****	**Con***	**Func****	**Con***	**Func****	**Con***	**Func****	**Con***	**Func****	**Con***	**Func****	**Con***	**Func****
0	7.90±0.31	8.90±0.31	7.90±0.31	8.90±0.31	7.90±0.21	8.65±0.47	7.90±0.21	8.65±0.47	7.70±0.48	9.00±0.00	7.70±0.48	9.00±0.00	7.90±0.31	9.00±0.00	7.90±0.31	9.00±0.00
15	7.50±0.70	8.40±0.51	7.70±0.82	8.45±0.76	7.70±0.82	8.25±0.63	7.85±0.81	8.60±0.48	7.55±0.76	8.20±0.42	7.70±0.82	8.50±0.52	7.60±0.69	8.30±0.48	7.70±0.82	8.50±0.47
30	7.40±0.51	8.20±0.42	7.60±0.69	8.35±0.41	7.70±1.05	8.20±0.42	7.80±1.22	8.50±0.70	7.30±0.94	8.10±0.31	7.60±0.69	8.40±0.51	7.40±0.69	8.10±0.31	7.60±0.69	8.55±0.49
45	7.25±0.79	8.10±0.87	7.40±0.80	8.25±0.58	7.25±0.88	8.20±0.42	7.50±0.94	8.25±0.63	7.20±1.15	8.00±0.66	7.55±0.76	8.45±0.68	7.30±1.05	8.30±0.42	7.55±0.76	8.40±0.51
60	7.20±0.88	8.05±0.89	7.35±0.62	8.10±0.87	7.20±0.42	8.10±0.69	7.60±0.51	8.30±0.48	7.15±0.47	8.00±0.81	7.50±0.52	8.30±0.48	7.10±0.31	8.10±0.56	7.55±0.59	8.40±0.51

Mean±S.D

cutlets containing carrots and oats was found higher than the control samples. The chicken meat cutlets remained acceptable up to two months of frozen storage period (-20± 20C). The quality characteristics of chicken meat cutlets packed in vacuum packages were better preserved than the chicken meat cutlets packed conventionally.

REFERENCES

Addis, P.B. 1986. Poultry muscle as food. In: Bechtel PJ (eds) Muscle as food. Academic Press, New York, pp. 371-404.

AOAC. 2000. Official methods of analysis. 16th Edn. *Association of Official Analytical Chemists*. Washington DC, USA.

Fernandez-Gines, J.M., Fernandez-Lopez, J., Sayas-Barbera, E. and Perez-Alvarez, J.A. 2005. Meat products as functional food: A review. *J. Food Sci.*, **70**: 37-43.

Foegeding, E.A., Lanier, T.C. and Hultin, H.O. 1996. Characteristics of edible muscle tissues. In: Fennema OR (eds) Food Chemistry. Marcel Dekker Inc, New York, pp. 880-931.

Gok, V., Obuz, E. and Akkaya, L. 2008. Effects of packaging method and storage time on the chemical, microbiological, and sensory properties of Turkish pastirma- A dry cured beef product. *Meat Sci.*, **80**: 335-344.

Jimenez- Colmenero, F., Reig, M. and Toldra, F. 2006. New approaches for the development of functional meat products. Advanced technologies for meat processing, Boca Raton, Fl Taylor and Francis group, pp. 275-308.

Juntachote, T., Berghofer, E., Siebenhandl, S, and Bauer, F. 2006. The antioxidative properties of Holy basil and Galangal in cooked ground pork. *Meat Sci.*, **72**: 446-456.

Kashyap, A., Thind, S.S. and Kaur, A. 2012. Development of Chicken Meat Patties Incorporating Natural Antioxidants. *Int. J. Food Sci. Technol.*, **2**: 27-40.

Martino, M.N. and Zaritzky, N.E. 1988. Ice crystal size modifications during frozen beef storage. *J. Food Sci.*, **53**: 1631-1637.

Modi, V.K., Sachindra, N.M., Nagegowda, P., Mahendrakar, N.S. and Rao, D.N. 2007. Quality changes during the storage of dehydrated chicken kebab mix. *Int. J. Food Sci. Technol.*, **42**: 827-835.

Singh, S., Bansal, M.L., Singh, T.P. and Kumar, R. 1991. Statistical methods for research worker. Kalyani Publishers, New Delhi, pp. 310-17.

Thind, S.S., Gupta, P. and Padda, G.S. 2006. Incorporation of wheat and corn germs as extenders in chicken meat patties. *Beverage Food World*, pp. 54-55.

Verma, A.K. and Banerjee, R. 2010. Dietary fibre as functional ingredient in meat products: a novel approach for healthy living-a review. *J. Food Sci. Technol.*, **47**: 247-257.