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Effect of flaxseed flour, grape peel and wheat gluten incorporation levels on the sensory quality of chicken meat patties

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The present investigation was planned to prepare meat patties containing flaxseed, grape peel and wheat gluten at acceptable levels and their shelf life of frozen chicken meat patties was standardized by consulting literature and by taking the opinion of taste panel members during standardization trails. Standardization of functional ingredients in chicken meat patties was done by incorporating different levels of flaxseed flour, grape peel and wheat gluten. Grape seeds were not found suitable for the incorporation in chicken meat patties on basis of organoleptic analysis. So, for further investigation only grape peel was incorporated in the preparation of chicken meat patties. Then trails of flaxseed flour was incorporated at 0, 5.0, 10.0, 15.0 and 20.0 per cent levels, grape peel at 0, 2.5, 5.0, 7.5 and 10.0 per cent levels and wheat gluten at 0, 1.0, 1.5, 2.0, 2.5 and 3.0 per cent levels as functional ingredient in the chicken meat patties for the standardization of recipes. On the basis of sensory evaluation, best levels of flaxseed flour (5.0%), grape peel (5.0%) and wheat gluten (1.5%) were selected for incorporation in final products *i.e.* chicken meat patties. The average scores for appearance, colour, flavour, juiciness, texture and overall acceptability decreased significantly ($p \leq 0.05$) with the increase in the frozen storage period in both conventional and vacuum packed, control and FGW chicken meat patties. The FGW chicken meat patties had a better overall acceptability as compared to control. They were more juicer, had better colour and flavour scores than the control.

Key Words : Chicken meat patties, Flaxseed flour, Grape peel , Wheat gluten conventional, Vacuum packed

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INTRODUCTION

Indian poultry sector has been growing at around 8-10 per cent annually over the last decade and at more than 15 per cent in last three years. The domestic broiler meat demand is expected to grow at around 15-18 per cent while table egg demand is expected to grow at 5-7 per cent over medium to long term (*www.icra.in*).

With the change in lifestyle, healthy, quick meals are the order of the day for the consumers, but many of the meals available at the supermarket are high fat, high salt nutritional nightmares. In such cases, low fat chicken products may prove to be a good option. The rapid expansion of fast food market has increased the demand

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for ready-to-eat snack foods like patties, meat balls and kebabs etc. Chicken patties are the most popular comminuted product, occupies prominent position due to its characteristic flavour and palatability. But, some process modifications like incorporation of binders to chicken patty can be embarked upon to enhance its yield, emulsion stability and cost diminution, without compromising the quality of the product (Raut *et al.*, 2011).

The concept of functional foods is gaining popularity, as consumers seek to improve their health in a more natural way than popping pills. They have shown to benefit one or more target functions in the body beyond normal nutritional effects. The benefit must be an improvement in health or well-being and perhaps a reduced risk of certain diseases. Research into developing healthier functional meats and meat products would prove advantageous to the meat industry and ultimately, the consumer, as the link between diet and chronic disease prevention continues to grow (Kandeepan *et al.*, 2007).

Flaxseed has recently gained attention as a functional food ingredient because of its unique nutrient profile and potential to affect the risk and course of cardio-vascular diseases and some cancers particularly hormone dependent cancers such as prostate and breast. The main components of flaxseed expressed on moisture free basis are 21 per cent protein, 28 per cent dietary fibre, 41 per cent fat. Flaxseed has unique fatty acid profile. It has high poly unsaturated fatty acid (PUFA), moderate in mono unsaturated fatty acid (MUFA) (18%) and low in saturated fatty acid (9%). Flaxseed oil contains 50 to 60 per cent alpha linolenic acid, which is a precursor of eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) (Bilek and Turhan, 2009).

Grapes (*Vitis vinifera*) have been heralded for their medicinal and nutritional value for thousands of years. Grapes are one of the best source of antioxidant phenolic compounds. Grapes and grape based products are one such class of dietary products that have shown cancer chemo-preventive potential and also known to improve overall human health. Grape seed extract is a rich source of polyphenolic compounds especially proanthocyanidins.

Wheat gluten may be defined as the cohesive, visco-elastic proteinaceous material prepared as a by-product of the isolation of starch from wheat flour. Although sold as a protein, gluten contains more than just protein. As a commodity, dry gluten usually contains approximately 75 per cent protein, upto 8 per cent moisture and varying amounts of starch, lipid and fibre. The unique adhesive, cohesive and film-forming characteristics of hydrated wheat gluten and its thermosetting properties form the basis of various types of applications in meat, fish and poultry products (Day *et al.*, 2006).

Keeping in view the above developments the present investigation was planned to prepare meat patties containing functional ingredients with following objectives:

– To optimize the level of incorporation of functional ingredients (flaxseed and wheat sgluten) and other natural antioxidants (coloured grape seeds/ skin) in chicken meat patties.

– To study the physico-chemical, functional and organoleptic quality of the chicken meat patties containing functional ingredients.

– To evaluate the effect of incorporation of functional ingredients and natural antioxidants on the shelf-life of chicken meat patties using different packaging conditions during frozen storage.

Flaxseed:

According to Institute of Medicine (2002). The flaxseed is also an excellent source (about 28%) of dietary fibre. About two third of the total fibre in flaxseed is insoluble which increase the bulk in digestive system, thus, aids in digestion and prevent constipation. These properties of fibre provide great protection against cancers. Whereas, remaining fibre portion of the flaxseed is soluble having the ability to lower cholesterol levels in the body. The soluble fibres also optimize the blood sugar concentrations.

Ramcharitar *et al.* (2005) stated that flaxseed had gained attention as a functional food ingredient because of its unique nutrient profile and potential to affect the risk and course of cardio-vascular diseases and some cancers particularly hormone dependent cancers such as prostate and breast. The main components of flaxseed expressed on moisture free basis are protein 21 per cent, dietary fibre 28 per cent, fat 41 per cent. Flaxseed has unique fatty acid profile. It has high PUFA (73% of total fatty acid), moderate in MUFA (18%) and low in saturated fatty acid (9%). Flaxseed oil contains 50 to 60 per cent alpha linolenic acid, which is a precursor of EPA and DHA.

Anonymous (2006) The flaxseed is also a rich source of polyunsaturated fatty acids consisting about 80 per cent of total oil with a high ratio of omega-3 to omega-6, both of which are essential and eaten as a part of diet since the body does not manufacture them from another source.

Valencia *et al.* (2008) found that flaxseed can be used successfully as enhancer in the manufacture of healthier meat products.

Bilek and Turhan (2009) concluded that flaxseed addition had a significant effect on the nutritional status of beef patties. The addition of flaxseed reduced the cooking loss of the product. They also stated that flaxseed flour can be used to enhance the nutritional value and health benefits of beef patties with minimal changes in composition and sensory properties.

Kapoor *et al.* (2011) stated that flaxseed is the richest known source of bothe alpha linolenic acid (ALA) and the phytoestrogens protect against cardio-vascular disease through a number of mechanisms including lowering of TC, LDL-C levels, blood pressure (BP) and triglycerides (TG). They may also help platelets from becoming sticky thus, reducing the heart attacks.

Grapes:

Han and Rhee (2002) found that polyphenolic compound containing plant materials such as rosemary, sage, alpha tocopherol, pine bark extract, green tea, coffee, grape skin, aloe vera, fenugreek, ginseng, mustard and soya protein can retard the development of warmed off flavor in meat products.

Mielnik *et al.* (2002) showed that tea and grape would probably be more effective preservatives in precooked or cooked meat products.

Carpenter *et al.* (2006) investigated the antioxidant effects of plant extracts (grape seed extract, bearberry, olive leaf extract and Echinacea purpurea) under conditions of oxidative stress induced by hydrogen peroxide. Grape seed extract and bearberry demonstrated the strongest antioxidant properties.

Mielnik *et al.* (2006) found that supplementation of ground turkey meat with grape seed extract before processing proved to be advantageous with regard to lipid stability of cooked turkey meat stored cold, especially in air, but also under vacuum. The efficiency of the grape seed extract increased with increasing antioxidant concentration in the studied range (0.4-1.6 g/kg). The addition of grape seed extract combined with vacuum-packaging should be considered as a good method to improve lipid stability in cooked poultry meat.

Brannan and Mah (2007) demonstrated that 0.1 per cent grape seed extract completely inhibited the formation of lipid hydroperoxides and thiobarbituric acid reactive substances (TBARS) in cooked beef, pork, chicken breast and thigh after 7d of refrigerated storage. This work also showed that grape seed extract was an effective antioxidant in cooked chicken breast and thigh during frozen storage.

Carpenter *et al.* (2007) studied that grape seed extract and bearberries displayed potent antioxidant activity in both raw and cooked pork patties, thus, demonstrating the potential for using natural antioxidants extracts in meat products.

Brenes *et al.* (2008) reviewed that in take of grape pomace increased antioxidant capacity in breast and thigh meat of broiler chickens.

Brannan (2009) came to a conclusion that grape seed extract may be an effective radical scavenger that in precooked chicken breast can reduce attributes associated with warmed over flavour such as musty flavors and odors. His work also showed that grape seed extract did not alter the pH, water activity and binding strength and yield.

Sasse *et al.* (2009) conducted studies which proved that grape seed extract was as effective as propyl gallate at preventing oxidation in cooked pork patties. Grape seed extract has the potential to be as powerful an antioxidant as synthetic antioxidants that are currently used in cooked, frozen meat products without adversely affecting meat colour.

Sáyago-Ayerdi *et al.* (2009) found that dietary grape pomace concentrate and grape antioxidant dietary fibre could be successful in retarding lipid oxidation of chilled and long-term frozen stored raw and cooked chicken patties.

Sadgic *et al.* (2011) found practical applications of Grape pomace which consists of seeds, skins and stems, and an important by-product that is well known to be the rich source of phenolic compounds, both flavonoids and non-flavonoids. These substances have considerable beneficial effects on human health. The use of natural antimicrobial compounds, like plant extracts of herbs and spices for the preservation of foods has been very popular issue because of their antimicrobial activity. Therefore, grape pomace should be added into some food formulations to benefit from their protective effects. In this respect, this study reports the effect of addition of grape pomace extracts obtained from different grape varieties on microbial quality of beef patty. The results obtained in this study may be useful for food industry, which has recently tended to use natural antimicrobial sources in place of synthetic preservatives to prevent microbial spoilage.

Wheat gluten:

According to Day *et al.* (2006) a desired property of gluten is its ability to bind fat and water while at the same time increasing the protein content; this makes gluten attractive for various types of application in meat, fish and poultry products. Gluten improves the utilisation of beef, pork and lamb meats by a restructuring process, which converts less desirable fresh meat cuts into more palatable steak-type products. Gluten has also proven as a satisfactory binder for turkey-meat pieces because of its ability to produce intact loaves with good slicing qualities. In processed-meat products, gluten is an excellent binder in poultry rolls, canned 'integral' hams and other non-specific loaf-type products, where it also improves slicing characteristics and minimises cooking losses during processing.

Xiong *et al.* (2008) stated that gluten, a co- product from the wet processing of wheat flour is mainly used in bakery industry to improve the rheological properties of flours due to its visco- elastic properties. But it can also be used as a binder or extender in meat products.

Zhang *et al.* (2010) reported that when wheat proteins at 3 per cent and 6 per cent were added to smoked sausages made with mechanically separated poultry meat, hardness of the product increased but springiness decreased. Addition of 3.5 per cent wheat protein flour increased water holding capacity and decreased cooking loss. The textural and sensory properties of frankfurters including viscosity, adhesiveness and batter stability were also improved.

Effect of packaging on meat products:

Dushyanthan *et al.* (2000) studied the effect of vaccum packaging on the microbial qualities *i.e.* TVC (Total Viable Count) of beef packed in 4 different periods under both chiller and freezer temperature as the storage period decreased.

Park *et al.* (2008) observed that pork belly had higher pH and thiobarbituric acid reactive substances (TBARS) value than the pork lion and aerobic packaged belly had higher TBARS than vaccum packaged counterparts. Overall, vaccum packaging was better than aerobic packaging to retard lipid oxidation and production of oxidative products and loin was more sensitive to lipid oxidation than belly.

Enver and Ergun (2011) studied the effects of various concentrations of O_2/CO_2 in modified atmosphere packaging on the microbiological quality and shelf-life of ostrich meat. The iliofibularis muscle was cut into small cubes that were divided into five groups and then separately packaged under various gas mixes: air and O_2:CO_2:N_2 ratios of 80:20:0, 60:20:20, 60:40:0, and 40:40:20, using 2 different headspace ratios (1:1 and 3:1). The meat quality and shelf-life of ostrich meat under various gas compositions were improved; microbial growth was delayed due to high CO_2 usage and shelf-life was increased by 5–7 days.

Xaio *et al.* (2011) conducted study to determine the effects of dietary treatment and packaging on the oxidative stability of chicken breast rolls. He found that dietary supplementation of antioxidants significantly reduced lipid oxidation and protein oxidation in breast rolls and also vacuum packaging significantly delayed the onset of lipid oxidation and protein oxidation in chicken rolls during 7 day refrigerated storage.

METHODOLOGY

The present investigation was conducted in the Department of Food Science and Technology, College of Agriculture, Punjab Agricultural University, Ludhiana. This chapter contains relevant information pertaining to design and methodological steps used in the investigation.

Raw materials:

Chicken meat:

Frozen minced chicken meat of republic of chicken brand (400g unit), was purchased from their outlet in Ludhiana and stored at -20$\pm$2°C in deep freezer, till its use in the preparation of chicken meat patties. The chicken meat was thawed using microwave oven (Batliboi Eddy Co. Model No. ER-5054 D) for 2 minutes at power level 4, just prior to the preparation of chicken meat patties.

Flaxseed:

Flaxseed was purchased from the local market of Ludhiana. The flaxseed was roasted and ground into flour using food processor (Kenstar Karishma Multi Processor, Model no. MF0808).

Grapes :

Fresh grapes were procured from the local market in Ludhiana and were washed. The berries were separated from the stem. Grape juice was extracted using food processor (Kenstar Karishma Multi Processor, Model no. MF0808). The juice was strained and peel was separated and frozen at -20±2°C till its incorporation in chicken meat patties.

Wheat gluten:

Vital wheat gluten of edible food quality was procured from M/s DKSH Indian Private Limited, New Delhi.

Garlic and ginger paste:

The ginger and garlic paste of Smith and Jones brand was procured from the local market in Ludhiana.

Spice mix and additives :

A pre-standardized formulation of dry spices was prepared (Table A). Cinnamon, coriander, cumin powders of MDH brand and black pepper of Catch brand were procured from the local Ludhiana market.

Food grade sodium alginate, calcium carbonate, sodium tripolyphosphate, sodium nitrite was procured from the reputed suppliers. Branded refined groundnut oil (Fortune) and Iodized salt (Tata) were used in the formulation.

Table A : Dry spice mix (100g)

Ingredients	Quantity (g)
Black pepper	19
Cumin	38
Coriander	38
Cinnamon	5

Packaging material:

Co-extruded plastic film (200 guage) suitable for conventional and vacuum packaging under freezing conditions was used for the packaging of chicken meat patties.

Standardization of product formulation

The recipe of chicken meat patties 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 standardization process also helped in the training of the taste panel members.

After standardizing of the recipe, the trials were conducted incorporating grape peel and grape seeds. Grape seeds were not found suitable for the incorporation in chicken meat patties on basis of organoleptic analysis. So, for further investigation only grape peel was incorporated in the preparation of chicken meat patties. Then trails of flaxseed flour was incorporated at 0, 5.0, 10.0, 15.0 and 20.0 per cent levels, grape peel at 0, 2.5, 5.0, 7.5 and 10.0 per cent levels and wheat gluten at 0, 1.0, 1.5, 2.0, 2.5 and 3.0 per cent levels as functional ingredient in the chicken meat patties for the standardization of recipes. On the basis of sensory evaluation, best levels of flaxseed flour (5.0%), grape peel (5.0%) and wheat gluten (1.5%) were selected for incorporation in final products *i.e.* chicken meat patties.

Preparation of patties:

The chicken meat mince, salt and sodium nitrite were mixed in Hobart mixer Model N-50 for three minutes. Flaxseed flour (5%), grape peel (5%) and wheat gluten (1.5%) were added followed by spices and other additives as per the formulation to form uniform batter.

The ingredients were mixed uniformly. The batter was moulded into patties in moulds (8 cm in diameter, 0.8 cm thick) by filling 80 grams of batter. The patties were precooked in at 200^0 C for 6 minutes and packed conventionally and sealed using heat sealer (Ambala Associates) and under vacuum using vacuum packaging machine (Teknik Industrial Traders, Ambala city Model D2Q400-2D) in co-extruded plastic films. The packed patties were frozen stored at (-20± 2°C) in commercial freezer upto two months.

Organoleptic analysis:

– Sensory evaluation for appearance, colour, texture, flavour, juiciness and overall acceptability was carried out the next day as per score card by a panel of minimum ten semi trained judges on nine point hedonic scale.

Proximate composition parameters:

Proximate composition was determined by following the methods.

Moisture:

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

Protein:

Macro kjeldahl method was used for determination of protein (AOAC, 2000). The sample (0.2 g) weighed was digested in Kjeldahl flask with digestion mixture (copper sulphate and potassium sulphate in 1:10 ratio) and concentrated H_2SO_4 (20 ml) till light green colour and cooled. Ammonia released by distillation of digested sample with saturated NaOH (80 ml) was captured in 0.1N HCL to calculate per cent nitrogen (N_2). The per cent nitrogen was converted into per cent protein as:

% Protein = % Nitrogen x 6.25

Crude fat :

Crude fat was extracted from dried sample of products with the help of Soxhlet Apparatus. Weighed sample was taken in thimbles and extracted using petroleum ether (boiling point 60-80ºC) for 16 hours. The extract containing fat and petroleum ether was evaporated over steam bath and dried in oven at low temperature (50°C), weighed and per cent fat was calculated.

Ash:

Ash content was determined by placing the charred samples in silica dishes and heated in muffle furnace at 525ºC for 6 hrs until white colour ash was obtained to a constant weight.

Crude fibre:

10 g of sample was digested with 200 ml of boiling 0.225 N sulphuric acid in heating mantle for 30 mins with condenser. After boiling, the contents were filtered in the fluted funnel and washed with boiling water to free from acids. This was then boiled with preheated 200ml of 0.313N NaOH for 30mins in heating mantle with condenser. The sample was then filtered and washed in fluted funnel. The material was dried, weighed and then ashed in the furnance at 540^{o}C. Substraction of ash weight from weight of acid, alkali treated sample give weight of crude fibre.

Cooking methods:

The chicken meat patties were cooked in microwave oven at 200^{o}C for 20 minutes to achieve an internal temperature of 80ºC. A container of water was placed inside the oven to maintain high humidity throughout the cooking process. The sides of patties were turned once in the middle of cooking process *i.e*. after an interval of 10 minutes.

Organoleptic evaluation:

The products were organoleptically evaluated on the day of preparation and at every 15 days interval during storage period. A ten member semi-trained sensory panel was selected from the faculty members of Punjab Agricultural University and postgraduate students. Nine-point Hedonic scale was used for evaluation of patties for appearance, colour, flavour, texture, juiciness and overall acceptability (Larmond, 1970).

Storage studies:

Chicken meat patties were prepared and packed in different packaging materials namely LDPE and vacuum packaging (HDPE) for chicken meat patties. Chicken meat patties were frozen stored (-20± 2°C) for estimation by conducting tests for changes in moisture content, protein content, free fatty acid content, peroxide value and overall acceptability at regular intervals of 15 days interval over a period of two months for chicken meat patties.

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 mean of three observations.

OBSERVATIONS AND ASSESSMENT

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Proximate composition of minced chicken meat, flaxseed flour, grape peel and wheat gluten:

Data given below in the Table 1 represents the proximate composition of raw materials like minced chicken, flaxseed flour, grape peel and wheat gluten used in the preparation of chicken meat patties.

Standardization of product formulation:

The recipe of chicken meat patties 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 patties is given in Table 1. The standardization process also helped in the training of the taste panel members.

After standardizing of the recipe, the trials were conducted incorporating grape peel and grape seeds. Grape seeds were not found suitable for the incorporation in chicken meat patties on basis of organoleptic analysis. So, for further investigation only grape peel was incorporated in the preparation of chicken meat patties. Then trails of flaxseed flour was incorporated at 0, 5.0,

Table 1: Proximate composition of raw materials

Raw materials	Moisture (%)	Protein (%)	Fat (%)	Ash (%)	Crude fibre (%)
Minced chicken	72.23 ± 0.02	18.94 ± 0.04	6.86 ± 0.15	1.19 ± 0.06	0.17 ± 0.05
Flaxseed flour	6.58 ± 0.02	19.61 ± 0.01	40.71 ± 0.02	3.9 ± 0.01	8.2 ± 0.03
Grape peel	81.06 ± 0.40	0.70 ± 0.01	0.13 ± 0.03	0.49 ± 0.01	0.85 ± 0.04
Wheat gluten	6.55 ± 0.02	89.75 ± 0.02	0.82 ± 0.02	0.60 ± 0.02	0.02 ± 0.01

Table 2 : Effect of flaxseed flour incorporation levels on the sensory quality of chicken meat patties (n=9)

Level of flaxseed flour (%)	Appearance	Colour	Texture	Flavour	Overall acceptability
0	7.27 ± 0.10	6.85± 0.05	7.28± 0.03	6.80± 0.03	7.08
5	8.08 ± 0.04	8.11± 0.02	7.87± 0.04	8.24± 0.05	8.13
10	7.62 ± 0.06	7.67± 0.02	7.64± 0.04	7.86± 0.04	7.77
15	7.54 ± 0.07	7.39± 0.03	7.3± 0.03	7.5± 0.04	7.5
20	7.2± 0.04	7.08± 0.03	6.8± 0.04	6.58± 0.06	6.79
C.D. (P=0.05)	0.200	0.113	0.110	0.127	0.134

Table 3 : Effect of grape peel incorporation levels on the sensory quality of chicken meat patties (n=9)

Level of grape peel (%)	Appearance	Colour	Texture	Flavour	Overall acceptability
0	7.08 ± 0.03	6.85± 0.03	7.12± 0.03	6.82± 0.02	7.02
2.5	7.23± 0.03	7.01± 0.04	7.28± 0.03	7.01± 0.02	7.09
5	7.77± 0.02	7.65± 0.05	7.69± 0.04	7.51± 0.04	7.79
7.5	7.19± 0.04	7.27± 0.03	7.29± 0.04	7.22± 0.02	7.26
10	6.58± 0.04	7.01± 0.04	7.18± 0.03	6.79± 0.04	6.88
C.D. (P=0.05)	0.091	0.117	0.101	0.0846	0.099

Table 4: Effect of wheat gluten incorporation levels on the sensory quality of chicken meat patties (n=9)

Level of wheat gluten (%)	Appearance	Colour	Texture	Flavour	Overall acceptability
0	7.10 ± 0.21	6.90 ± 0.11	7.24 ± 0.20	6.97 ± 0.26	7.05
1	7.27 ± 0.17	7.01 ± 0.14	7.34 ± 0.11	7.05 ± 0.22	7.17
1.5	7.86 ± 0.14	7.78 ± 0.20	8.10 ± 0.12	7.91 ± 0.20	7.91
2	7.72 ± 0.13	7.58 ± 0.08	7.94 ± 0.16	7.66 ± 0.12	7.73
2.5	7.30±0.17	7.04±0.14	7.20±0.14	7.22±0.21	7.19
3	7.05±0.21	6.75±0.13	6.80±0.13	6.81±0.26	6.85
C.D. ($P\leq 0.05$)	.050	.045	.042	.062	.021

10.0, 15.0 and 20.0 per cent levels, grape peel at 0, 2.5, 5.0, 7.5 and 10.0 per cent levels and wheat gluten at 0, 1.0, 1.5, 2.0, 2.5 and 3.0 per cent levels as functional ingredient in the chicken meat patties for the standardization of recipes as given in Table 2, 3 and 4. On the basis of sensory evaluation, best levels of flaxseed flour (5.0%), grape peel (5.0%) and wheat gluten (1.5%) were selected for incorporation in final products *i.e.* chicken meat patties.

Appearance, colour, texture, flavour and overall acceptability scores were maximum at 5 per cent level of flaxseed incorporation. So this level was selected and also beyond that there was perceptible change in flavour and its colour darkened.

Fresh grape peel when incorporated above 5 per cent had deteriorative effect on appearance, colour, texture, flavour and also on patty making property. So 5 per cent level was selected.

Similarly as shown in Table 4 when vital wheat gluten was added upto 3 per cent there was drastic decrease in texture and flavour scores and also on texture and overall acceptability scores. So 1.5 per cent level was selected for incorporation based on these sensory scores.

Chicken meat patties:

The chicken meat patties were prepared after selecting the best levels of flaxseed (5%), grape peel (5%) and vital wheat gluten (1.5%) as per the recipe given in material and methods. The patties so prepared were packed both conventionally and under vaccum and stored under frozen storage till further analysis.

Conclusion:

It was concluded that good quality chicken meat patties can be produced by incorporating functional ingredients *i.e.* flaxseed flour, grape peel and wheat gluten at 5 per cent, 5 per cent and 1.5 per cent levels, respectively.

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