Haryana Vet. **52** (December, 2013) pp 6-11 **Research Article**

DEVELOPMENT AND QUALITY EVALUATION OF CHICKEN PATTIES INCORPORATED WITH PSYLLIUM HUSK

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ABSTRACT

This investigation was carried out to develop high fibre chicken meat patties using psyllium husk. Three different levels (4, 6 and 8 percent) of psyllium husk were tried. On the basis of results of physico-chemical properties, proximate composition and sensory evaluation, its incorporation at 4% level was found suitable. The patties with 4% psyllium husk had significantly higher total dietary fibre content than control. The cholesterol content was found to be significantly lower in psyllium husk incorporated patties than control. During storage at 4±1°C, the psyllium husk added patties were found to be microbiologically safe and organoleptically acceptable up to 15 days. It can be concluded that addition of psyllium husk at 4% level increases dietary fibre content of patties without deteriorating quality parameters.

Key words: Chicken patties, psyllium husk, dietary fibre, storage, quality evaluation

Poultry meat has a great potential for delivering important nutrients like quality proteins, minerals and vitamins. Value added poultry meat products are gaining wide consumer base. The changes in socioeconomic factors in recent years have increased the consumer's preference for ready to eat foods including meat products. However, most of these foods are rich in fat and sugars and deficient in complex carbohydrates like dietary fibre (Sanchez-Zapata *et al*., 2010). Epidemiological research has demonstrated the relationship between diet deficient in dietary fibre and other complex carbohydrates and increase in number of diseases, including colon cancer, obesity and cardiovascular diseases (WHO/FAO, 2003). Therefore inclusion of dietary fibre in daily diet has been recommended for adults.

In meat products, fibre is now being used as the most common functional ingredients as fat replacer, volume enhancer, binder and stabilizer (Fernandez-Lopez *et al*., 2008; Kumar *et al*., 2011). Apart from the nutritional properties, dietary fibre is also used for technological upgradation like improvement in cooking yields and rheological properties, reducing formulation costs and enhancing the texture in meat products (Sanchez-Zapata *et al*., 2010; Mehta *et al*., 2013).

The plants in the genus *Plantago* are commonly known as Psyllium. It is locally known as Isabgol or Ispaghula and has beneficial effects such as laxative action, and potential cholesterol lowering and hypoglycemic effects. Though much research has been conducted to investigate the health promoting effects of psyllium husk, a very few studies have been done on developing food products fortified with psyllium like bread (Kaur *et al.*, 2011) and aqueous food products (Colliopoulos *et al.*, 1984). Hence, this study was conducted to utilize the psyllium husk as a source of dietary fibre in meat products.

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MATERIALS AND METHODS

Birds, Ingredients and Processing: Live broiler chicks of 6 weeks of age reared under similar feeding and management conditions were obtained from the Animal Farm of the College of Veterinary Sciences, LUVAS, Hisar. The birds were slaughtered by halal method and dressed as per the standard procedure. Carcasses were washed thoroughly and deboned manually after trimming of fat and connective tissue. Deboned meat was stored at -20°C till further use. Psyllium husk (B.G. Telephone brand, Sidhpur Sat Isabgol factory) was procured from local market. The cholesterol free refined sunflower oil (Fortune, Adani Wilmer Ltd., Ahmedabad, India) was procured from local market. To prepare garlic paste, peeled garlic was cut into small pieces and homogenised in the mixer grinder to obtain a fine paste. Low density polyethylene (LDPE) pouches (50μm thick) were procured from local market, sterilized by exposing to UV light for 30 min and were used for aerobic packaging for the storage studies. All other chemicals used in study were procured from Hi-Media Laboratories Pvt. Ltd., Mumbai.

Preparation of Chicken Patties: The frozen deboned meat was defrosted in a refrigerator overnight. The defrosted meat was cut into small pieces and minced in a meat grinder (Seydelmann, Model WD 114, Germany) using 13 mm plate followed by 8 mm plate. The contact surface of the grinder was sanitized each time before mincing. Control patties contained sodium chloride (2%), sodium tripolyphosphate (0.5%), sodium nitrite (150 ppm), spice mix (2%), garlic paste (3%) and sunflower oil (3%). Treatments in addition to ingredients in control patties contained psyllium husk at 4% (T1), 6% (T2) and 8 % (T3) level thereby decreasing the meat content proportionately. After mixing of additives and dietary fibre source, meat mince was thoroughly chopped in bowl chopper (Seydelmann K20 Ras, Germany) to prepare emulsion. For the preparation of patties, the emulsion was moulded in petri dish and cooked in preheated conventional electrical oven at 180ºC for 25 min (15 min first and 10 min second side) till an internal temperature of around 75ºC was reached. For microbiological quality assessment, samples were packed in LDPE bags and stored at refrigeration temperature (4±1°C). Samples were drawn at every 3 days interval for 15 days and analyzed for proximate, physico-chemical, microbiological and sensory qualities. The samples were taken in duplicate and the experiment was replicated thrice.

Analytical Procedures: The proximate composition was determined by following the standard methods of AOAC (1995). The pH of emulsion and cooked patties was determined as per Trout *et al.* (1992). The emulsion stability of control and treated raw meat was determined using the method of Baliga and Madaiah (1970). For determination of cooking yield, the weight of patties before and after cooking was recorded and yield was expressed in percentage. Total cholesterol was determined by adopting the Tschugaeff reaction as modified by Hanel and Dam (1955). For estimation of dietary fibre (total, insoluble and soluble), an enzymatic method given by Furda (1981) was followed. Thiobarbituric acid reactive substances (TBARS) value was determined according to the method of Witte *et al*. (1970). The method as described by Konieko (1979) was followed for the estimation of free fatty acids (FFA).

Microbiological Evaluation: Microbiological quality of the best selected treatment after proximate and sensory quality evaulation and control was evaluated at 0, 3, 6, 9, 12 and 15th day of storage at refrigeration (4±1ºC) temperature. Total plate counts (TPC), psychrotrophic counts (PPC) and coliforms counts (CC) in the samples were enumerated following the methods as described by American Public Health Association (APHA, 1984).

Sensory Evaluation: A panel consisting of scientists and postgraduate students of the Department evaluated the sensory attributes *viz:* colour, flavour, texture, tenderness, juiciness and over all acceptability of control and fibre incorporated chicken meat patties using a 8-point hedonic scale. The panellists were explained about the nature of experiments without disclosing the identity of the samples and were asked to rate their preferences. Filtered tap water was provided for mouth rinsing between the samples.

Statistical Analysis: The statistical analysis of the data was done using ANOVA technique by Randomized Block Design (Snedecor and Cochran, 1989).

RESULTS AND DISCUSSION

Proximate Composition of Psyllium Husk: The moisture, protein, fat and ash content of psyllium husk was 9.68, 1.13, 0.27 and 2.07%, respectively. Total dietary fibre (TDF) content was 81.28%. The majority of TDF, based on testing in the laboratory, was soluble dietary fibre (SDF) *i.e.* 73.38% and the remaining (7.91%) was insoluble dietary fibre (IDF).

Physico-chemical Properties: The addition of psyllium husk did not change pH values of raw emulsion and cooked patties (Table 1). Caceres *et al*. (2004) also reported that the incorporation of soluble dietary fibre did not affect the pH of cooked sausages. Wu and Lin (2011) reported that the addition of xylo-oligosaccharides in raw meat balls did not alter the pH values. Slightly higher pH was observed in the cooked patties as compared to raw emulsion in this study. Babu *et al*. (1994) attributed the increase in pH to loss of moisture on cooking resulting in increased salt concentration and change in net protein charges due to denaturation. With an increase in level of psyllium husk, a significant ($p<0.05$) increase in the emulsion stability was observed in treated as compared to control patties. This could be due to the presence of higher amount of SDF entrapping and holding moisture in the form of a gel during application of heat. Similar trends in emulsion stability in locust/xanthan gum added frankfurters (Luruena-Martinez *et al*., 2004) and in low salt meat emulsions added with sea weeds (Cofrades *et al.,* 2008) were reported. An increase in level of incorporation of psyllium husk increased the cooking yield significantly ($p<0.05$). An increased level of SDF was reported to increase the yield by uptake of free water and reducing the cooking loss (Mansour and Khalil, 1999). Similar findings were also reported by Garcia-Garcia and Totosaus (2008) in low fat sodium reduced sausages added with different gums.

Proximate Composition: The moisture content decreased with an increasing level of psyllium husk in patties (Table 1) which was due to replacement of lean meat by psyllium husk that contained comparatively less moisture (9.68%) than meat. A similar decrease in moisture with higher level of SDF has been reported by Caceres *et al.* (2004) in both conventional and reduced fat sausages and by Garcia *et al*. (2006) in mortadella.

A decrease in protein content of patties added with psyllium husk as compared to control was due to contribution of carbohydrates from the husk. Psyllium husk contained very less amount of protein (1.13%) and is a very rich source of dietary fibre (81.28%). Garcia *et al.* (2006) reported a similar decline in protein content of mortadella added with inulin both in powder and gel forms. Cierach *et al.* (2009) also concluded that the protein content of low fat frankfurters decreased with an increasing amount of carrageenan.

A slight decrease in fat content of psyllium husk added patties could be due to fat replacing and substitution property of soluble dietary fibre. Also, the soluble dietary fibre source used in this study contained a negligible amount of fat (0.27%). These findings are in accordance with those of Yilmaz and Daglioglu (2003) and Yasarlar *et al*. (2007).

No significant difference in ash content was observed among treatment and control. However, lower ash percentage as compared to control at higher level of incorporation of SDF *viz*. 8, 10 and 12% has been reported by Caceres *et al.* (2004). Contrary to our findings, Yasarlar *et al*. (2007) reported an increase in ash content in konjac/ gellan gum added, reduced fat frankfurters and oat bran added meat balls respectively.

Sensory Scores: There was a decrease in color with incorporation of psyllium husk; the psyllium husk being white and translucent in appearance might have diluted the red colour of meat rolls (Table 1). The decreasing trend in the flavour scores of psyllium husk incorporated patties as compared to control was due to dilution of meaty flavour. However, the flavour of T1 was well comparable with control as compared to T2 and T3 treatments. A decrease in tenderness was observed but the tenderness scores of T1 were also well comparable to control as compared to T2 and T3. The decrease in tenderness score may be due to the softening of products on incorporation of a soluble dietary fibre. Caceres *et al*. (2004) reported a similar decreasing trend in tenderness scores on addition of fructo-oligosaccharides in sausages. Sensory panellists rated psyllium husk added patties slightly better than control for juiciness attribute. The gel matrices formed in psyllium husk added patties were perceived as juicy by panellists.

Table 1
Physico-chemical properties, proximate composition and sensory attributes of psyllium husk added chicken patties

Parameters	Control	Levels of psyllium husk incorporation		
		4% (T1)	6% (T2)	8% (T3)
Emulsion pH	5.88±0.06	5.87±0.06	5.88±0.09	5.89±0.05
Emulsion stability (%)	86.63±0.68^{d}	92.45±0.97^{c}	96.19±0.81^{b}	98.73±0.71^{a}
Product pH	6.35±0.07	6.37±0.07	6.38±0.10	6.41±0.06
Cooking yield (%)	86.00±0.88^{d}	90.02±1.07^{c}	92.16±1.18^{b}	94.48±1.08^{a}
Moisture (%)	62.28±0.70^{a}	60.41±0.75^{ab}	59.73±0.81^{b}	59.00±0.86^{c}
Protein (%)	26.44±0.75^{a}	22.31±0.85^{b}	20.72±0.92^{c}	19.96±0.88^{d}
Fat (%)	7.66±0.82	7.42±0.97	7.21±0.79	7.17±0.89
Ash (%)	1.60±0.10	1.51±0.07	1.53±0.09	1.56±0.11
Colour	8.50±0.55^{a}	8.00±0.89^{ab}	7.33±0.52^{bc}	6.83±0.75^{c}
Flavour	8.00±0.89^{a}	7.33±0.52^{a}	6.50±0.55^{b}	6.00±0.63^{b}
Tenderness	8.00±0.63^{a}	7.00±0.89^{b}	5.83±0.75^{c}	5.33±0.52^{c}
Juiciness	6.83±0.75	7.00±0.89	7.17±0.75	7.50±0.84
Texture	8.33±0.82^{a}	7.17±0.75^{b}	6.00±0.63^{c}	5.50±0.55^{c}
Overall acceptability	8.17±0.75^{a}	7.33±0.82^{b}	6.33±0.52^{c}	5.50±0.55^{d}

Mean±S.D. with different superscripts (a,b,c,d) for a parameter in each row differ significantly ($p<0.05$); n=6

So, the scores for juiciness increased probably due to the gel formation by psyllium husk's soluble dietary fibre in the products. Similar findings were reported by Caceras *et al.* (2004) on incorporation of fructo-oligosaccharides in cooked sausages. Garcia *et al.* (2006) also reported that juiciness scores increased from 5.38 to 7.09 when inulin was added at 7.5% as gel in mortadella.

The texture scores showed a proportionately decreasing trend with an increase in level of psyllium husk as compared to control. The sensory panellists rated T1 in moderate acceptability range. However, with increase in levels of husk, the scores decreased. This might be due to formation of gel matrices in meat protein. Garcia *et al.* (2006) also stated the similar explanation for lower texture scores in inulin supplemented mortadella. The scores for overall acceptability showed a decreasing trend with an increase in level of psyllium husk. A significantly ($p<0.05$) lower overall acceptability scores were obtained for all the levels of psyllium husk incorporated patties as compared to control but for T1, the scores were above 7 and were in moderate acceptability range. Addition of psyllium husk at 6 and 8% levels significantly ($p<0.05$) lowered scores than at 4% level. Hence 4% psyllium husk incorporation level (T1) for patties was selected for further studies.

Cholesterol and Dietary Fibre Contents: A significant ($p\leq0.05$) reduction in cholesterol content on addition of psyllium husk was observed (Table 2) as also reported by Mansour and Khalil (1999) in wheat bran added beef burgers. The SDF content of T1 was significantly ($p\leq0.05$) higher than that of controls. IDF content of both control and T1 did not differ much. However, the control samples had significantly ($p\leq0.05$) lower TDF content than T1. An increase in TDF content in chicken patty on addition of dietary fibre sources has been reported (Wan Rosli *et al*., 2011).

Storage Quality: The control and T1 were packed in LDPE and their quality at refrigerated temperature was evaluated at an interval of 3 days for 15 days.

Physico-chemical Characteristics: An increasing trend in the pH of the control and T1 was observed but a significant ($p\leq0.05$) increase was detected at 12th day of storage (Table 3). It could be due to the production of alkalizing substances especially amines from breakdown of protein by the microorganisms (Jay, 2004). The results of this study are in consonance with the findings of Yadav and Sharma (2008). The TBARS values increased gradually with the advancement of storage period and were comparable in control and T1 treatment. Similar trend was being followed for the FFA values during storage. A significant ($p\leq0.05$) increase in FFA content with the increase in storage period was probably due to enzymatic or microbial lipolysis of fat. The presence of psyllium husk had not exerted any protective effect in inhibiting the oxidative rancidity in the chicken meat patties.

Table 2
Total cholesterol and dietary fibre content of psyllium husk added chicken patties

Parameters	Control	T1
Total cholesterol (mg/100g)	89.43±2.12[a]	72.64±2.32[b]
SDF (%)	0.16±0.09[b]	2.77±0.34[a]
IDF (%)	0.22±0.07[a]	0.18±0.10[a]
TDF (%)	0.33±0.16[b]	2.95±0.37[a]

Mean±S.D. with different superscripts in a row for a parameter differ significantly ($p<0.05$); n=3
T1=Chicken patties incorporated with 4% psyllium husk; SDF=Soluble dietary fibre; IDF=Insoluble dietary fibre; TDF=Total dietary fibre

Microbiological Quality: TPC showed a gradual increase from 0 to 15th day in control and T1, however, the values were well within the permissible limits for cooked meat products at all days as prescribed by Jay (2004). The TPC did not differ significantly between control and treatment on 0 day and also with the progress of the storage period (Table 3). Psychrotrophic count of control and T1 did not differ significantly at any point during storage but followed an increasing trend from 0 to 15th day (Table 3). A similar increase in psychrotrophic count during storage has been reported by Yadav and Sharma (2008). The coliforms were not detected throughout the storage period in both control and T1 which could be due to cooking at temperature above their thermal death point of 57ºC. Further, hygienic practices followed during and after preparation of the products could be the additional reasons for the absence of coliforms. Similar findings have also been observed in pork patties (Kumar and Sharma, 2004) and dehydrated chicken kebab mix (Modi *et al*., 2007).

Sensory Attributes: The appearance scores of control and T1 did not differ significantly (Table 3) throughout storage period. A progressive decrease in flavour scores of control and T1with an increase in storage time might be due to increased lipid oxidation resulting in malonaldehyde formation, liberation of free fatty acid and

Table 3
Effect of refrigeration storage (4±1°C) on physicochemical, microbiological and sensory parameters of chicken patties incorporated with psyllium husk

Treatment	Group	Storage Period (Days)					
		0	3	6	9	12	15
pH	Contol	$6.28^{c}\pm0.05$	$6.30^{bc}\pm0.05$	$6.30^{bc}\pm0.05$	$6.34^{abc}\pm0.07$	$6.37^{ab}\pm0.07$	$6.39^{a}\pm0.06$
	T1	$6.31^{c}\pm0.07$	$6.33^{b}_{c}\pm0.05$	$6.34^{bc}\pm0.06$	$6.37^{abc}\pm0.05$	$6.39^{ab}\pm0.06$	$6.41^{a}\pm0.06$
TBARS	Control	$0.83^{c}\pm0.07$	$0.89^{c}\pm0.09$	$1.12^{c}\pm0.11$	$1.39^{c}\pm0.06$	$1.67^{c}\pm0.08$	$1.84^{c}\pm0.07$
	T1	$0.76^{c}\pm0.06$	$0.87^{c}\pm0.08$	$1.03^{c}\pm0.09$	$1.26^{c}\pm0.07$	$1.51^{c}\pm0.08$	$1.64^{c}\pm0.09$
FFA Values	Control	$0.47^{f}\pm0.05$	$0.58^{e}\pm 0.06$	$0.69^{d}\pm0.07$	$0.78^{c}\pm0.04$	$0.93^{b}\pm0.04$	$1.02^{a}\pm0.05$
	T1	$0.45^{e}\pm0.06$	$0.51^{de}\pm0.05$	$0.57^{d}\pm0.04$	$0.73^{c}\pm0.05$	$0.87^{b}\pm0.07$	$0.95^{a}\pm0.06$
TPC	Control	$2.79^{d}\pm0.38$	$3.10^{d}\pm0.31$	$3.83^{c}\pm0.38$	$4.47^{b}\pm0.43$	$5.26^{a}\pm0.44$	$5.63^{a}\pm0.38$
	T1	$2.74^{e}\pm0.45$	$3.08^{e}\pm0.36$	$3.67^{d}\pm0.33$	$4.29^{c}\pm0.31$	$5.00^{b}\pm0.48$	$5.48^{a}\pm0.46$
Psychrotrophic count	Control	$1.88^{e}\pm0.47$	$2.03^{de}\pm0.36$	$2.39^{cd}\pm0.43$	$2.83^{c}\pm0.36$	$3.29^{b}\pm0.32$	$3.94^{a}\pm0.38$
	T1	$1.86^{e}\pm0.40$	$1.99^{de}\pm0.39$	$2.36^{cd}\pm0.35$	$2.68^{bc}\pm0.37$	$3.12^{b}\pm0.45$	$3.79^{a}\pm0.36$
Coliform count	Control	ND	ND	ND	ND	ND	ND
	T1	ND	ND	ND	ND	ND	ND
Colour	Control	8.33±0.52	8.17±0.75	8.17±0.41	7.83±0.75	7.83±0.41	7.67±0.52
	T1	8.17±0.75	8.17±0.98	8.00±0.63	7.50±0.55	7.50±0.84	7.33±0.52
Flavour	Control	8.00 ± 0.63^{a}	8.00 ± 0.89^{a}	7.67 ± 0.52^{ab}	7.50 ± 0.55^{ab}	7.33 ± 0.52^{ab}	7.00 ± 0.63^{b}
	T1	8.00 ± 0.63^{a}	7.67 ± 0.52^{ab}	7.67 ± 0.82^{ab}	7.33 ± 0.52^{abc}	7.00 ± 0.63^{bc}	6.67 ± 0.52^{c}
Texture	Control	8.33±0.52	8.17±0.75	8.17±0.98	7.83±0.75	7.50±0.55	7.50±0.84
	T1	7.33±0.82	7.33±0.82	7.17±0.75	6.83±0.75	6.83±0.98	6.50±0.55
Tenderness	Control	8.17±0.75	8.17±0.98	8.00±0.63	7.83±0.75	7.50±0.55	7.33±0.52
	T1	7.17±0.75	7.17±0.98	7.00±0.63	6.83±0.75	6.50±0.55	6.33±0.52
Juiciness	Control	8.00 ± 0.63^{a}	8.17 ± 0.75^{a}	7.83 ± 0.41^{b}	7.50 ± 0.55^{abc}	7.17 ± 0.75^{bc}	6.83 ± 0.75^{c}
	T1	8.00 ± 0.63^{a}	8.00 ± 0.89^{a}	7.50 ± 0.55^{ab}	7.33 ± 0.82^{ab}	7.00 ± 0.63^{b}	6.83 ± 0.75^{b}
Overall Acceptability	Control	8.17 ± 0.75^{a}	8.17 ± 0.98^{a}	8.00 ± 0.63^{ab}	7.83 ± 0.41^{ab}	7.33 ± 0.82^{ab}	7.17 ± 0.75^{b}
	T1	7.50±0.55	7.33±0.52	7.33±0.82	7.00±0.63	7.00±0.89	6.83±0.41

Mean±S.D. with different superscripts in a row for a parameter differ significantly ($p\leq0.05$); ($p\leq 0.05$); n=6; T1=Chicken patties incorporated with 4% psyllium husk; TBARS=Thiobarbituric acid reacting substances; FFA=Free fatty acid; TPC=Total plate count

increased microbial load (Kumar and Sharma, 2004, Gadekar *et al*., 2009). At the end of storage period, the scores were significantly ($p\leq0.05$) lower than 0 day but were within the acceptable range as reported by the panellists. The scores for texture for T1 were significantly lower than that of control on day 0 and showed a decreasing trend with an increase in storage period. A gradual decrease in tenderness might be due to loss of moisture and fat during storage. A similar decrease in tenderness score during storage has been reported by Biswas *et al.* (2011) in duck patties. Juiciness scores of control and T1 were highest at 0 day and followed a decreasing trend throughout the storage period. This might be due to loss of moisture from the product as LDRE packages are permeable to moisture. A significant ($p\leq0.05$) decline in overall acceptability scores for control was observed only at 15th day of storage, however, for T1, the decline was non-significant throughout the storage period. The progressive reduction in overall acceptability scores with an increase in storage period was a resultant of decreased values of other sensory attributes. Increased lipid oxidation, protein degradation and some bland flavour due to fat degradation are mainly responsible for lower overall acceptability scores. However, for control and T1 these scores were well in the acceptable range even at the end of the storage period.

It can be concluded from this study that addition of psyllium husk (4%) was suitable and resulted in a significant decrease in cholesterol content and an increase in dietary fibre content of chicken patties while the proximate composition, physicochemical properties and sensory attributes were similar to that of control. During refrigeration (4±1ºC) storage for 15 days, the product was found to be microbiologically safe and organoleptically acceptable. Hence, it can be used as a regular dietary fibre source for designing the meat products rich in fibres.

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