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# Utilization of Barley in the Development of Fiber Enriched Chevon Cutlets

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## ABSTRACT

A study was conducted to evaluate the possibility of utilization of barley as a source of fiber in the development of fiber-enriched designer chevon cutlets. Three levels of barley flour viz. 2, 4 and 6 percent were incorporated replacing lean meat in the formulation. The products developed were assessed for various physico-chemical, sensory, texture and colour parameters. pH, crude fiber, ash content, texture parameters like hardness, adhesiveness, springiness, cohesiveness, chewiness, gumminess and product redness value showed significant ($P<0.05$) increasing trend whereas flavor, juiciness and overall acceptability decreased significantly ($P<0.05$) with increasing levels of incorporation. Based on various physico-chemical and sensory parameters, chevon cutlets containing 4 percent barley flour were optimized as best.

***Keywords :*** *Cutlets, Chevon, Barley, Fiber, Quality characteristics*

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## INTRODUCTION

Meat cutlets are convenient ready-to-eat meat products that are famous throughout the world and are commonly consumed in breakfast or supper. Meat cutlets are flat croquettes of minced meat and other ingredients like flours, pulses, shredded potato, condiments and spices and are often coated with rusk crumbs. Besides being rich in high biological value proteins, meat cutlets are energy dense and rich in fats and are not suitable for a health conscious society. Thus, there is an immediate need for the development of designer versions of the product.

A strong relationship has been demonstrated between the emergence of a range of chronic diseases and a diet containing an excess of energy-dense foods by various epidemiological studies (Bhat *et al*. 2013a;Bhat and Bhat 2011b; Bhat *et al.* 2011b;Biswas *et al*. 2011;Beecher 1999). A positive association has been observed between meat consumption and colorectal cancer (Sadri and Mahjub 2006). Accordingly an increase in the level of dietary fiber in the daily diet has been recommended for the prevention or control of many chronic diseases (Bhat and Bhat 2011a; Bhat and Bhat 2011b; Yang *et al.* 2007;Eastwood 1992; Johnson and Southgate 1994). Several studies have proven that dietary fibers have the potential to reduce blood low density lipoprotein cholesterol (Brown *et al*.1999), risk of diabetes mellitus type 2 (Willet *et al.* 2002), coronary heart disease (Bazzano *et al.* 2003), blood pressure (Streppel *et al.* 2005), obesity (Liu 2003) and colorectal cancer (Tharanathan and Mahadevamma 2003; Schatzkin *et al.* 2007). Being suitable for addition to meat products, different sources of fibers have been used in meat products to increase the cooking yield due to its water-binding and fat-binding properties and to improve texture (Cofrades *et al*. 2000). Fibers from different sources have been utilized in the development of fiber fortified meat products (Bhat *et al*. 2013a; Bhat *et al*. 2011a; Grigelmo-Miguel *et al*. 1999;Modi *et al*. 2003; Bhat and Pathak 2009; Yilmaz 2004), however, no information is available on the utilization of barley as a source of dietary fiber in the development of chevon cutlets. Barley (*Hordeum sativum*) is a good source of both soluble and insoluble fiber and contains significant levels of beta-glucans and dietary fiber of around 15.6 percent (Ahmad *et al*. 2014). Beta-glucans, the major fiber constituent of barley, has been implicated in lowering plasma cholesterol, improving lipid metabolism and reducing glycemic index (Behall *et al.* 2006;Keenan *et al.* 2007). The utilization of barley in the development of chevon cutlets is still an unexplored area.

Keeping in view all the above facts the present study was envisaged to attempt the still inconclusive studies on utilization of barley in the development of fiber-fortified chevon cutlets. A study was designed to evaluate the effect of different levels of barley flour on the physicochemical, sensory, texture and colour properties of chevon cutlets.

## MATERIALS AND METHODS

### *Source of meat*

The chevon meat comprising semimembranosus, semitendinosus, biceps fimoris, quadriceps femoris and gastrocnemiusmuscles was obtained from adult *Bhakarwal* goat carcass from the market of Jammu. The body fat was trimmed and deboning was done manually by removing all the tendons and separable connective tissue.

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The lean meat was packed in polythene bags and stored under frozen conditions at -18 ± 2$^0$C until use.

### *Fat*

Refined cottonseed oil of brand name "*Sheerji*" was purchased from local market and used in emulsion preparation. It approximately contained 900 k.cal of energy, 0 gm of carbohydrate, 0 gm of proteins, 0 gm of cholesterol, 16 gm of saturated fatty acids, 23.5 gm of mono-unsaturated fatty acids, 60.5 poly-unsaturated fatty acids and 0 gm of trans-fatty acids per 100 gm.

### *Condiment mixture*

Condiments used were fresh onion, garlic and ginger. The external covering of all were peeled off and cut into pieces. The cut pieces were weighed in a ratio of 3:2:1 and ground in a mixer to the consistency of fine paste.

### *Spice mixture*

The spice mix formula used for preparation of the chevon cutlets was standardized in the laboratory and contained aniseed (*Pimpinalla anisum*) 10%, coriander (*Coriandrum* ) 15%, cumin seed (*Cuminum cyminum*) 15%, black pepper (*Piper nigrum*) 10%, red chilli (*Capsicum frutescens*) 7%, caraway seed (*Trachyspermum copticum*) 5%, green cardamom *Elettaria cardamomum*) 5%, white pepper (*Piper nigrum*) 5%, cardamom (*Amomum subulatum*) 5%, cinnamon (*Cinnamomum zeylanicum*) 5%, degi mirch (*Capsicum annum*) 5%, turmeric *Curcuma longa*) 5%, bay leaves (*Laurus nobilis*) 2%, cloves *Syzygium aromaticum*) 2%, mace (*Myristica fragrans*) 2% and nutmeg (*Myristica fragrans*) 2%.

### *Barley flour*

Barley flour of a commercial brand was purchased from the local market and used in the preparation of chevon cutlets at various levels viz. 0, 2, 4 and 6 percent replacing lean meat in the formulation. The flour contained approximately 14% dietary fiber, 12% moisture, 11% protein content, 1.5% fat and 1.5% ash.

### *Method of preparation of chevon cutlets*

Several preliminary trials were conducted to optimize the basic formulation and processing conditions for the preparation of chevon cutlets. The standardized formulation contained lean meat 74%, added water 3%, shredded potato 5%, condiment mixture 10%, gram flour 2%, whole egg liquid 2%, spice mixture 2%, common salt 1.75%, sugar 0.25% and sodium nitrite 120 ppm.

Lean meat from round part of goat carcass was cut into smaller chunks and minced in a Sirman mincer (MOD-TC 32 R10 U.P. INOX, Marsango, Italy) with 6 mm plate twice. The common salt, sugar, sodium nitrite and added water in the form of crushed ice was added to weighed meat according to above formulation and was kept at refrigeration temperature (4±1$^0$C)for 15-20 min. The mixture was shallow fat fried in 2.5 percent w/w refined oil for 8 min. The condiment and spice mixture was fried separately till golden brown colour. The fried meat, condiment and spice mixture, gram flour, shredded potato and whole egg liquid were mixed in a domestic mixer. The batter so formed was used in the preparation of raw cutlets by using moulds. The raw cutlets were kept at refrigeration temperature for 15-20 min and dipped in whole egg liquid and then rolled in rusk powder till uniform coating was formed on the surface and were deep fat fried in refined oil till golden brown colour. The internal core temperature was measured with the help of a thermometer (80±2$^0$C) and the excess fat was removed from the fried cutlets by using tissue paper.

### *Analytical procedures*

### *pH*

The pH of chevon cutlets was determined by the method of Keller *et al.* (1974) using a digital pH meter (Systronics Digital pH Meter 803, serial No. 603).

### *Cooking yield*

The weight of each cutlet was recorded before and after cooking. The cooking yield was calculated and expressed as percentage by a formula:

$$\text{Cooking yield percent} = \frac{\text{Weight of cooked chevon cutlet}}{\text{Weight of raw chevon cutlet}} \times 100$$

### *Proximate analysis*

Moisture, crude protein, crude fat and ash contents in both treatment samples and control were determined by using standard procedures prescribed by AOAC (2000).

### *Rusk pick up*

The rusk pick up percent was determined as per formula given by Hsia *et al.* (1992) by noting the weights of cutlets before and after rusk pick up.

$$\text{Rusk pick up (\%)} = \frac{\text{Weight of cutlet after dusting - weight of cutlet before dusting}}{\text{Weight of cutlet before dusting}} \times 100$$

### *Product shrinkage*

Shrinkage of the product was calculated using the formula given by El-Magoli *et al.* (1996) with suitable modification, i.e., the diameter of the fried cutlets was represented by the average length and breadth of the oval shaped cutlets.

$$\text{Shrinkage (\%)} = \frac{\text{(Raw thickness-Cooked thickness) + (Raw diameter-Cooked diameter)}}{\text{Raw thickness + Raw diameter}} \times 100$$

### *Sensory evaluation*

The sensory evaluation of the products was carried for various attributes namely colour and appearance, flavour, juiciness, texture and overall acceptability by a panel of seven trained members composed of scientists and research scholars of the division based on a 8-point hedonic scale, wherein 8 denoted "extremely desirable" and 1 denoted "extremely undesirable" (Seman *et al.* 1987).

### *Texture profile analysis*

The textural properties of the products were evaluated by using the texturometer (Stable Micro System TA. XT2i/25) at Division of Livestock Products Technology, GADVASU, Ludhiana, India. Texture profile analysis (Bourne 1978) was performed using central cores of each sample (1.5 cm x 1.5 cm x 1.5 cm) which were compressed to 60 percent of the original height. A crossed head speed of 3 mm/sec was used.

### *Colour measurement*

The colour parameter of the product was monitored by evaluating Hunter 'L', 'a' and 'b' values using ColorTec PCM+ (ColorTec Associates Inc., Clinton, NJ, USA). Hunter L (lightness), a (redness) and b (yellowness) values were measured on the outer surface of cutlets from three randomly chosen spots.

### *Statistical analysis*

Means and standard errors were calculated for different parameters. Data obtained in the study was analyzed statistically on 'SPSS-16.0' software package as per standard methods (Snedecor and Cochran 1994). Duplicate samples were drawn for each parameter and the experiment was replicated thrice (n=6). Sensory evaluation was performed by a panel of seven member judges three times, so total observations being 21 (n=21). Data was subjected to one way analysis of variance for comparing the means.

## RESULTS AND DISCUSSION

### *Physicochemical characteristics*

The mean values of various physicochemical parameters namely pH, cooking yield, rusk pick up, product shrinkage and proximate composition of chevon cutlets incorporated with 0, 2, 4 and 6 percent levels of barley flour are presented in Table 1.

### *pH*

Mean pH values of the raw as well as cooked chevon cutlets increased significantly (P<0.05) with incorporation of barley flour and was significantly (P<0.05) highest at 6 percent level. Increase in pH with increase in extension level was expected because of neutral nature of barley flour and was in agreement with findings of Bhaskar *et al.* (2012), Bhat and Pathak (2012) and Bhat and Pathak (2011) who also reported a similar increase in the pH of low-fat chicken sausages, *shish* and *seekhkababs* incorporated with oat flour, cowpea and green gram, respectively. Kumar and Sharma (2006) also observed a similar in pH of chicken patties extended with barley flour.

**Table-1 : Effect of barley flour on the physicochemical and proximate parameters of chevon cutlets (Mean±SE)***

| Parameters | Barley flour level (%) | | | |
|---|---|---|---|---|
| | 0 | 2 | 4 | 6 |
| | **Raw Chevon Cutlets** | | | |
| pH | 5.92±0.01$^{a}$ | 5.95±0.02$^{ab}$ | 5.97±0.02$^{b}$ | 5.99±0.02$^{b}$ |
| Moisture (%) | 57.25±0.68$^{b}$ | 55.95±0.88$^{ab}$ | 54.30±0.85$^{ab}$ | 54.21±0.73$^{a}$ |
| Fat (%) | 10.05±.0.57$^{b}$ | 8.90±0.53$^{ab}$ | 8.65±0.47$^{ab}$ | 8.24±0.47$^{a}$ |
| Protein (%) | 17.98 ±0.52 | 17.58±0.46 | 17.42±0.50 | 17.21±0.48 |
| Ash (%) | 2.72±0.03 | 2.76±0.01 | 2.79±0.03 | 2.82±0.03 |
| Crude fiber (%) | 0.33±0.01$^{a}$ | 0.54±0.02$^{b}$ | 0.79±0.01$^{c}$ | 0.95±0.02d |
| | **Cooked Chevon Cutlets** | | | |
| pH | 6.09±0.01$^{a}$ | 6.11±0.02$^{ab}$ | 6.13±0.01$^{b}$ | 6.14±0.02$^{b}$ |
| Moisture (%) | 49.55±1.03$^{b}$ | 48.49±0.94$^{ab}$ | 46.52±0.70$^{ab}$ | 45.92±1.18$^{a}$ |
| Fat (%) | 13.57±0.75 | 12.68±0.41 | 12.48±0.35 | 11.86±0.62 |
| Protein (%) | 18.94±0.41 | 18.31±0.40 | 18.06±0.42 | 17.81±0.42 |
| Ash (%) | 2.76±0.03$^{a}$ | 2.80±0.02$^{ab}$ | 2.83±0.03$^{b}$ | 2.86±0.03$^{b}$ |
| Crude fiber (%) | 0.36±0.02$^{a}$ | 0.62±0.02$^{b}$ | 0.83±0.02$^{c}$ | 0.98±0.02$^{d}$ |
| Rusk pick-up (%) | 5.78±0.33 | 5.49±0.42 | 5.36±0.32 | 5.65±0.37 |
| Cooking Yield (%) | 94.97±0.42 | 95.52±0.51 | 96.04±0.58 | 96.17±0.56 |
| Shrinkage (%) | 1.00±0.15 | 0.91±0.12 | 0.84±0.14 | 0.73±0.13 |

*Mean with different superscript differ significantly (P<0.05) in a row, n= 6 for each treatment.

### *Cooking yield and shrinkage percent*

Cooking yield showed a non-significant (P>0.05) increase with increasing level of barley flour whereas products showed a non-significant (P>0.05) decrease in percent shrinkage with increase in the level of incorporation. Increase in cooking yield may be attributed to the hydrocolloidal fibers (β-glucans) which hold both water and fat in a tridimensional matrix (Giese 1992; Inglett *et al*. 1994). Similar results were also observed by Bhaskar *et al.* (2012) and Suman and Sharma (2003) in low-fat chicken sausages and buffalo patties, respectively. Kumar and Sharma (2006) also reported a similar decrease in percent shrinkage of chicken patties extended with barley flour.

### *Rusk pick-up percent*

A non-significant (P>0.05) decrease was observed in the rusk pick-up percent of the chevon cutlets with increase in the level of incorporation of barley flour. This might be attributed to the decreasing level of moisture with increasing level of incorporation of barley flour as moisture content of the products facilitate the large pick-up of the rusk material (Essien

### *Proximate composition*

### *Moisture*

Moisture content of both raw as well as cooked chevon cutlets showed a significant (P<0.05) decreasing trend with increasing level of incorporation of barley flour and was lowest (P<0.05) at 6 percent level. It may be attributed to comparatively less moisture content of barley flour than lean chevon. Verma *et al.* (2013) also reported a similar decrease in the moisture content of cooked sheep meat nuggets incorporated with guava powder.Similar observation was also reported by Huang *et al.* (2011) in Chinese-style sausages incorporated with oat fiber.

### *Crude protein and fat*

The crude protein and fat content of the cooked products showed a non-significant (P>0.05) decrease with incorporation of barley flour whereas the crude fat content of the raw products showed a significant (P<0.05) decrease with incorporation. This may be attributed to the dilution effect caused by incorporation of barley flour which is particularly low in protein and fat content. Similar findings were reported by Huang *et al.* (2011) and Bhaskar *et al.* (2012). Suradkar *et al.* (2013) also reported a decrease in the protein and fat content of chicken nuggets containing bread crumbs. Verma *et al.* (2013) also observed a decrease in the protein and fat content of sheep meat nuggets incorporated with guava powder. Verma *et al.* (2012a) and Verma *etal.* (2012b) also reported similar results in different meat products. Taludkar and Sharma (2009) observed a decrease in protein content of chicken meat patties incorporated with wheat and oat bran.

### *Ash*

A significant (P<0.05) increase was observed in the ash content of the cooked products whereas a non-significant (P>0.05) increase was observed in the ash content of the raw products with increasing levels of incorporation which may be attributed to the higher mineral content of the barley flour in comparison to the meat. Similar results were reported by Verma *et al.* (2013) for sheep meat nuggets incorporated with guava powder.

### *Crude fiber*

A significant (P<0.05) increase was observed in crude fiber content of the chevon cutlets with increase in the level of incorporation which may be attributed to the higher fiber content of the barley flour (Kumar and Sharma 2006). Similar increase in the fiber content was also observed by Verma *et al.* (2013); Das *et al.* (2013); Verma *et al.* (2012a); Verma *et al.* (2012b);Bhaskar *et al.* (2012); Huang *et al.* (2011) and Taludkar and Sharma (2009) in different meat products.

### *Instrumental colour*

The effect of barley incorporation on the hunter colour value of chevon cutlets is presented in Table 2. Although, hunter lightness and yellowness values did not affect significantly, incorporation of barley flour significantly (P<0.05) improved the product redness value with increasing level of barley flour. Extension of meat products with flours has been reported to improve the colour values of the meat products and the probable reason may be attributed to the browning caused by the addition of flours rich in carbohydrates. Similar increase in the product redness value was also reported by Verma *et al.* (2013) for sheep meat nuggets incorporated with guava powder. Verma *et al.* (2010) also reported an increase in redness value of low salt, low fat chicken nuggets on incorporation of apple pulp. A significant (P<0.05) increase in redness value of bologna sausages incorporated with cooked lemon albedo was also reported by Fernandez-Gines *et al*. (2004).

**Table-2 : Effect of barley flour on the hunter colour value of chevon cutlets (Mean±SE)***

| Parameters | Barley flour level (%) | | | |
|---|---|---|---|---|
| | 0 | 2 | 4 | 6 |
| L (Lightness) | 54.86±0.93 | 55.52±0.68 | 56.15±0.86 | 54.98±1.20 |
| a (Redness) | 7.80±0.37$^{a}$ | 8.36±0.27$^{a}$ | 10.88±0.64$^{b}$ | 11.65±0.63$^{b}$ |
| b (Yellowness) | 15.76±0.67 | 14.75±0.48 | 15.07±0.57 | 15.47±0.64 |

*Mean with different superscript differ significantly (P<0.05) in a row, n= 6 for each treatment.

### *Texture profile analysis*

The textural property of chevon cutlets incorporated with barley flour is presented in Table 3. Texture profile analysis revealed significant increase (P<0.05) in hardness, cohesiveness, adhesiveness, springiness, gumminess and chewiness with incorporation of barley flour (may be attributed to its waterabsorption capacity). Further the high amount of fiber in the formulation probably plays a role in the formation of firm three dimensional gel matrix and textural properties of meat products. Huang *et al.* (2005) reported increase in hardness value with the increasing levels of rice bran in the emulsified pork meatballs. Similar result was also reported by Garcia *et al.* (2002) in low fat dry fermented sausages added with 3% wheat and oat. Grigelmo-Miguel *et al.* (1999) reported an increase in gumminess value of low fat, high dietary fibre frankfurters as the concentrations of peach fibre increased. Increase in the chewiness value of emulsified pork meatballs with respect to higher levels of rice bran was also reported (Huang *et al.* 2005).

**Table-3 : Effect of barley flour on the texture profile analysis of chevon cutlets (Mean ± SE)***

| Parameters | Barley flour level (%) | | | |
|---|---|---|---|---|
| | 0 | 2 | 4 | 6 |
| Hardness (N/cm$^2$) | 24.31±0.74$^a$ | 33.46±0.64$^b$ | 35.41±0.70$^b$ | 41.44±0.72$^c$ |
| Adhesiveness (Ns) | 0.02±0.01$^a$ | 0.02±0.02$^a$ | 0.06±0.02$^b$ | 0.07±0.02$^c$ |
| Springiness (cm) | 0.62±0.01$^a$ | 0.85±0.03$^b$ | 0.86±0.02$^b$ | 0.94±0.03$^c$ |
| Cohesiveness (ratio) | 0.25±0.03$^a$ | 0.31±0.04$^{ab}$ | 0.41±0.06$^b$ | 0.85±0.06$^c$ |
| Chewiness (N/cm) | 12.54±0.50$^a$ | 13.41±0.49$^{ab}$ | 15.30±0.68$^b$ | 18.04±0.60$^c$ |
| Gumminess (N/cm$^2$) | 14.62±0.48$^a$ | 16.52±0.60$^{ab}$ | 18.54±0.80$^b$ | 22.44±0.70$^c$ |

*Mean ± SE with different superscripts in a row differ significantly (P<0.05).

### *Sensory attributes*

The mean values of various sensory parameters namely appearance and colour, flavour, juiciness, texture and overall acceptability of chevon cutlets incorporated with 0, 2, 4 and 6 percent levels of barley flour are presented in Table 4. Appearance and colour scores of chevon cutlets showed a non-significant (P>0.05) increase up to 4 percent level of incorporation of barley flour and thereafter decreased at 6 percent level. This could be due to the production of product with lighter colour which was desirable up to 4 percent level of incorporation. Modi *et al.* (2009) also reported increased lightness in meat *kofta* incorporated with oat flour.

A significant (P<0.05) effect was observed on the flavour and juiciness scores of the chevon cutlets. Flavour scores decreased significantly (P<0.05) with increase in the level of barley flour and the scores were significantly lowest (P<0.05) at 6 percent level. This could be due to the masking of meaty flavour by barley flour. These observations are in agreement with the findings of Bhat *et al.* (2013b) and Bhat and Pathak (2009) in chicken meat balls and chicken *seekh kababs,* respectively. Juiciness scores showed a significant decrease (P<0.05) at 6 percent level of incorporation as compared to control although, it was comparable (P>0.05) in the products prepared with 2 and 4 percent barley flour. Lower juiciness scores of the products with the increased levels of barley flour might be due to graininess perceived by sensory panelists (Claus and Hunt 1991) and lower moisture percent in the product.Yilmaz and Daglioglu (2003) reported decrease in juiciness score with increased levels of oat bran in meatballs. Similar decrease in juiciness scores was also reported by Verma *et al.* (2013) for sheep meat nuggets incorporated with guava powder and by Verma *et al.* (2012a) in chicken nuggets incorporated with chickpea hull flour.

**Table-4 : Effect of barley flour on the sensory attributes of chevon cutlets (Mean±SE)***

| Parameters | Barley flour level (%) | | | |
|---|---|---|---|---|
| | 0 | 2 | 4 | 6 |
| Appearance and colour | 6.86±0.06$^{ab}$ | 7.02±0.08$^b$ | 7.01±0.10$^b$ | 6.75±0.08$^a$ |
| Flavour | 7.00±0.06$^b$ | 6.88±0.05$^{ab}$ | 6.84±0.05$^{ab}$ | 6.72±0.06$^a$ |
| Juiciness | 6.99±0.07$^b$ | 6.92±0.05$^b$ | 6.85±0.06$^{ab}$ | 6.74±0.05$^a$ |
| Texture | 6.78±0.05 | 6.80±0.04 | 6.79±0.07 | 6.65±0.06 |
| Overall acceptability | 7.01±0.06$^b$ | 6.94±0.06$^b$ | 6.91±0.05$^b$ | 6.79±0.04$^a$ |

*Mean±SE with different superscripts in a row differ significantly (P<0.05), n = 6 for each treatment

The mean scores for texture of the chevon cutlets showed a non-significant (P>0.05) decline with increasing levels of incorporation. Lower texture scores of the products could be due to disruption of batter matrix by the addition of barley flour. A decrease in texture scores was reported by Verma *et al.* (2012a) in chicken nuggets incorporated with chickpea hull flour. The mean scores for overall acceptability of the products showed a significant (P<0.05) decline although, the mean scores for the products up to 4 percent incorporation were comparable with control. The lower general appearance, flavor, texture and juiciness might have contributed to the significantly (P<0.05) lower overall acceptability scores for the products incorporated with barley flour. Similar findings were reported by Verma *et al.* (2012a) in chicken nuggets incorporated with chickpea hull flour. A decrease in overall acceptability score of emulsified pork meatballs with increasing levels of rice bran was observed by Huang *et al.* (2005). Similar result was also found by Yilmaz (2004) in low fat meatballs incorporated with rye bran and Kumar and Sharma (2006) in chicken meat patties incorporated with barley

## CONCLUSOION

Thus, the present study showed successful utilization of barley flour in the development of fiber enriched chevon cutlets. The products incorporated with 4 percent barley flour had almost similar sensory attributes and acceptability as control cutlets. It may be concluded that fibre enriched chevon cutlets of very good acceptability and nutritive value could be developed by utilizing 4 percent barley flour in the formulation.

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