Optimization of Processing Conditions and Level of Extenders Used for the Preparation of Extended Restructured Mutton Chops

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ABSTRACT

Appropriate binding of meat pieces and high water retention are two most important factors in marketing high quality processed meat products. Here, the non-meat ingredients play pivotal role and can improve the appearance, palatability and texture of the finished products. In this experiment, processing conditions viz., massaging time (8 min, 10 min and 12 min) and cooking time (35 min, 40 min and 45 min) as well as the level of extenders viz., pea hull flour (3%, 4% and 5%) and boiled and mashed potato (3%, 4% and 5%) were studied at different levels to see the effect on sensory attributes. Massaging times did not significantly influence the sensory scores but 10 min of massaging time was optimum. Sensory scores at cooking time of 45 min were significantly higher (P<0.05) for texture than other timings. Cooking time of 40 min was selected as optimum. Level of pea hull flour and boiled and mashed potato were selected at the level of 5% as the texture and binding scores were significantly lower for this level. Thus, it can be concluded that extended restructured mutton chops could be prepared by massaging the chunks of meat for 10 min and extension of product was brought by using peahull flour (5%) and boiled and mashed potato (5%).

INTRODUCTION

According to FAO (2009), India ranks 7th in mutton production in the world and constitutes 6.1% of world's sheep population which contributes 2.8% of world's mutton production. Lean red meats are excellent sources of high biological value protein, vitamin B_{12}, niacin and also act as sources of a range of endogenous antioxidants and other bioactive substances including taurine, carnitine, carnosine, ubiquinone, glutathione and creatine (Williams 2007).Thus, the characteristics of mutton such as high nutritive value and its gradual increasing demand in other countries provide a wide scope for research. Due to the changing consumer demand and increasing global competition, new processing technologies and new ingredient systems are embraced by meat product manufacturing sector. One such approach is the restructuring technology. Restructured meat products include any meat products that are partially or completely disassembled and then reformed into the same or a different form (Pearson and Gillett 1996). In the development of restructured mutton chops, portion of meat is to be bound on the rib bone which poses serious problems if the binding of the meat is inadequate.

There are various factors affecting restructured meat product quality. The methods of producing the particles of meat used in restructured meat have substantial impact on the quality attributes of the product. Grinding the meat is the most commonly adopted method because of its ease of use (Boles and Shand 1998). Other methods of size reduction such as slicing, chunking (Raharjo *et al.* 1994), flaking (Berry *et al.* 1987) and fiberizing (Raharjo *et al.* 1994). The major problem with large particle size is the need to use meat with less connective tissue (Marriott *et al.* 1986). Three basic procedures, (1) chunking and forming (2) flaking and forming and (3) tearing and forming, are used in reducing particle size and production of restructured meat (Pearson and Gillett 1996). Pulses, the edible seeds of leguminous crops, are a rich food source of dietary fibres that promote various beneficial physiological effects for human health. In addition to physiological advantages, technical properties such as a high water and fat binding capacity makethem optimal ingredients for achieving high yields and reduced cost.

Pietrasik (2010) reported the utilization of pea flour, starch-rich and fiber-rich fractions in low fat bologna. Potato is the most preferred vegetable for the incorporation into meat balls (Gunson *et al.* 1973). Berry and Wergin (1993) studied the effect of modified potato starch in ground patties and concluded that it improved the cooking yield, moisture retention and tenderness. Yang *et al.* (1995) reported that potatoes are popular not only for their functional properties but also for low cost relative to other alternatives.

Keeping the literature survey in view, Pea hull flour and boiled and mashed potato were selected to be used as extenders for preparation of restructured mutton chops and different massaging time (8 min, 10 min and 12 min) and cooking time (35 min, 40 min and 45 min) were chosen to study the effect on the sensory attributes of restructured mutton chops.

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MATERIALS AND METHODS

Procurement of mutton and ribs

Sheep (6-12 months) were slaughtered and dressed in experimental abattoir of LPT Division, IVRI, Izatnagar. Mutton, thus obtained was packed in clean polyethylene bags and brought to the laboratory. It was deboned manually. Ribs were also collected at the same time from the abattoir and stripped off the meat with knife. Deboned mutton and ribs were finally packed in clean polyethylene bags and frozen at -20^0C until use.

Extenders and other ingredients

Pea hull flour and potato were procured from local market of Bareilly along with refined salt (Tata Chemicals Ltd., Mumbai) and refined wheat flour (Maida). Spices were prepared in laboratory as per pre-standardized formulation. The powders were mixed in suitable proportion as shown in Table 1. For the preparation of condiments, onion was peeled off, cut into small pieces and homogenized in a mixer to obtain a fine paste. Garlic paste was purchased from the local market of Bareilly.

Table 1: Formulation of spice mix used for the preparation of Extended Restructured Mutton Chops

Ingredients	Percentage
Coriander powder (Dhaniya)	17
Cumin seed (Jeera)	10
Aniseed (Soanf)	10
Black pepper (Kalimirch)	10
Caraway seed (Ajowan)	10
Turmeric (Haldi)	10
Dried ginger	10
Capsicum (Mirch powder)	8
Cardamom (Bada Elaichi)	5
Cinnamon (Dal chini)	5
Cloves (Laung)	3
Nutmeg (Jaibhal)	1
Lace (Jaipatri)	1
Total	**100**

Massaging time for processing of restructured mutton chops

Three batches, each containing 500 gm of mutton chunks were put in peddle mixer with salt (1.75%), nitrite(150 ppm) and phosphate (0.5%) dissolved in water, condiments and spices and massaged for three different timings viz., 8 min, 10 min and 12 min at a constant speed. The mix obtained was bound on the ribs and cooked for 40 min by broiling. Based on the sensory attributes, optimum massaging time was selected.

Cooking time for processing of restructured mutton chops

Three batches, each containing 500 gm of mutton chunks were put in peddle mixer with salt, nitrite and phosphate dissolved in water, condiments and spices and massaged for the optimum time selected as per above experiment. Each of the mix obtained was bound on the three bones and cooked by broiling method (250^0C) for three different timings viz., 35 min, 40 min and 45 min. Based on the core temperature and sensory attributes, optimum cooking time was selected.

Different level of pea hull flour and boiled and mashed potato in restructured mutton chops

For this, three levels of pea hull flour viz., 3%, 4% and 5% (1:1 hydration w/w) and three different levels of boiled and mashed potato viz., 3%, 4% and 5% were incorporated in the pre-standardized formulation replacing lean meat. Restructured mutton chops were prepared. Three trials were conducted. Based on the product yield and sensory attributes, optimum level of extenders was worked out.

Sensory analysis

Sensory scores were given by the experienced panelists on the basis of 8-point Hedonic scale where 8=extremely liked and 1= extremely disliked (Keeton 1983), drawn from scientists and P.G students of LPT division.

Statistical Analysis

The statistical design of the study was 4 (treatments) X 3 (replications) randomized block design. There were seven sensory determinations for each treatment-replication combination. The data generated from various trials under experiment were pooled, processed and analyzed by statistical method of one way-ANOVA and Mean±S.E using SPSS software package developed as per the procedure of Snedecor and Cochran (1995) and means were compared by using Duncan's multiple range test (Duncan 1955).

RESULTS AND DISCUSSION

Optimization of massaging time for the preparation of restructured mutton chops

Mean sensory scores of extended restructured mutton chops prepared by using three different massaging times viz., 8 min, 10 min and 12 min are given in Table 2. The different massaging times did not significantly ($P>0.05$) influence any of the sensory attributes of restructured mutton chops. However, flavour, binding, juiciness scores were higher for 10 min massaging time than the other two timings. Booren *et al.* (1981) reported the increase in binding and tenderness with the increasing mixing time for sectioned and formed beef steaks. Overall acceptability scores were also higher for 10 min timing for massaging, which might be attributed to better juiciness and flavour of the product. But, the general appearance of extended restructured mutton chops showed gradual decreasing trend with increasing massaging time. Sensory scores for flavor, binding, juiciness and overall acceptability

of mutton chops prepared with 10 min massaging time were higher than the product massaged for 8 min and 12 min. Thus, 10 min timing for massaging was selected as optimum for further studies.

Optimization of cooking time for the preparation of restructured mutton chops

In this experiment, meat chunks were mixed for 10 min with other ingredients and the mix so obtained was bound on to the ribs and kept for different cooking times viz., 35 min, 40 min and 45 min. Mean scores for the different sensory attributes have been presented in Table 2. There was a significant difference (P<0.05) in the texture of the restructured mutton chops due to different cooking times. However, the texture scores for the cooking time of 35 min and 45 min were comparable. No significant differences were recorded for other sensory attributes. Flavour, overall acceptability and texture of the restructured products showed slightly higher scores at cooking time of 40 min, whereas the scores for general appearance and juiciness were higher at cooking time of 35 min. On the basis of sensory scores, it was found that the product cooked for 40 min was most accepted by the sensory panelists and hence, it was taken as optimum and selected for further experiments.

Table 2 : Effect of massaging and cooking time on the sensory attributes of extended restructured mutton chops (Mean±S.E.)*

Sensory attributes	Massaging time		
	8 min	10 min	12 min
Appearance	7.08±0.04	7.00±0.05	7.00±0.05
Flavour	7.05±0.03	7.12±0.04	7.07±0.04
Binding	6.88±0.04	6.93±0.03	6.85±0.04
Texture	7.00±0.04	6.90±0.03	6.90±0.06
Juiciness	7.04±0.06	7.12±0.05	7.01±0.04
Overall Acceptability	7.07±0.04	7.10±0.04	7.03±0.05
	Cooking time		
	30 min	35 min	40 min
General Appearance	7.19±0.04	7.08±0.07	7.09±0.07
Flavour	7.06±0.06	7.23±0.07	7.04±0.08
Binding	6.91±0.03	7.00±0.04	7.01±0.06
Texture	6.70±0.05[b]	7.26±0.05[a]	7.02±0.06[b]
Juiciness	7.30±0.07	7.22±0.06	7.17±0.06
Overall Acceptability	7.03±0.04	7.08±0.06	6.95±0.05

* Mean±S.E. with different superscripts in a row differ significantly (P<0.01).
Based on 8-point descriptive scale where 1: extremely undesirable and 8: extremely desirable n=21 for each treatment

Optimization of the levels of pea hull flour for the preparation of extended restructured mutton chops

Mean sensory scores and cooking yield for restructured mutton chops extended with different levels of PHF viz., 3%, 4% and 5% are presented in Table 3. There was no significant difference (P>0.05) in cooking yield of the products. However, there was gradual increase in the cooking yield of the product with increasing levels of PHF. The increase in the cooking yield might be attributed to the increased water retaining capacity by granules of PHF. There was no significant difference (P>0.05) in the general appearance, flavor, juiciness and overall acceptability of the product with different levels of PHF. However, the binding score of the product with 3% PHF was significantly higher (P<0.05) than the product with 5% PHF and comparable to the level of 4% level. Similar results (P<0.05) were obtained for the texture of the product. There was marginal increase in the juiciness of the product with 5% PHF than the product containing 3% PHF. This increase in juiciness may be attributed to more water retention by the extender. Overall acceptability scores were highest for the product with 5% PHF, which might be due to increased juiciness and flavor of the product at the same level.

Table 3 : Effect of peahull flour extension on the sensory attributes of restructured mutton chops (Mean±S.E.)*

Parameters	Level of pea hull flour (hydrated 1:1)		
	3%	4%	5%
Cooking yield(%)	84.65±0.51	85.69±0.84	86.83±0.86
Sensory Attributes			
General appearance	7.11±0.06	7.24±0.05	7.18±0.04
Flavour	7.02±0.07	7.01±0.04	7.06±0.06
Binding	7.11±0.07a	7.05±0.08ab	6.89±0.09b
Texture	7.19±0.07a	7.05±0.08ab	6.98±0.10b
Juiciness	6.88±0.09	6.87±0.05	6.90±0.10
Overall Acceptability	7.01±0.08	6.90±0.04	7.05±0.05

*Mean±S.E. with different superscripts in a row differ significantly (P<0.05).
Based on 8-point descriptive scale where 1: extremely undesirable and 8:extremely desirablen1(CY)=3 and n2(sensory attributes)=21 for each treatment

Optimization of the level of boiled and mashed potato for the preparation of restructured mutton chops

Boiled and Mashed potato was incorporated at the level of 3%, 4% and 5% by replacing the lean meat in pre-standardized restructured mutton chops formulation. Cooking yield and mean sensory scores for the products with different levels of potato are presented in Table 4. Cooking yield showed no significant difference (P>0.05) between the different levels of BMP, although, there was gradual increase in the percent cooking yield with the increase in BMP level. This could be

attributed to gelatinizing property of increasing starch component on heating. Martin *et al.* (2000) observed that 5 percent potato starch incorporation in pork batter significantly improved the moisture retention. Among the sensory attributes, texture and overall acceptability scores of the product were significantly different ($P<0.05$).

Mean sensory score for general appearance showed increasing trend with increase in level of extender. However, scores for flavor were lower at 5% incorporation level than at 4% level. The decreasing trend may be due to the dilution of meaty flavor with the increase in BMP. Binding scores for all the products revealed decreasing trend with increasing incorporation level of BMP, which might be because of moisture retention leading to fractionalization of restructured meat mass. Texture scores were significantly lower ($P<0.05$) in the product containing 5% BMP than at 3% and 4%. Decline in texture score was obviously due to softening of the products. However, Juiciness and overall acceptability scores of the product were higher for the product with 5% BMP and thus showed increasing trend with increase in the level of incorporation. Hence, on the basis of sensory scores and cooking yield, 5% level of boiled and mashed potato was selected for the preparation of extended restructured mutton chops along with 5% pea hull flour.

Table 4 : Effect of boiled and mashed potato extension on the sensory attributes of extended restructured mutton chops (Mean±S.E.)*

Parameters	Level of boiled and mashed potato		
	3%	4%	5%
Cooking yield (%)	84.79±0.80	85.84±0.78	87.02±0.95
	Sensory Attributes		
General			
Appearance	6.94±0.05	6.96±0.08	7.10±0.06
Flavour	7.05±0.06	7.22±0.07	7.13±0.05
Binding	6.87±0.07	6.80±0.05	6.73±0.06
Texture	6.95±0.04[a]	6.88±0.05[ab]	6.79±0.06[b]
Juiciness	6.79±0.06	6.85±0.05	6.89±0.07
Overall			
Acceptability	6.83±0.09[b]	6.89±0.05[b]	7.24±0.05[a]

*Mean±S.E. with different superscripts in a row differ significantly ($P<0.01$).
Based on 8-point descriptive scale where1: extremely undesirable and 8: extremely desirablen1(CY)=3 and n2(sensory attributes)=21 for each treatment

CONCLUSION

Texture and overall acceptability of restructured meat product depends on various factors, the most important being massaging time and cooking time. Improper massaging and cooking time may lead to hardening of the product and thus, decreasing its acceptability. The massaging time of 10 min yielded maximum scores for almost all sensory attributes and cooking time of 40 min was selected as optimum. Incorporation of different extenders in processed mutton is in common practice by commercial meat processors. Among the extenders, two widely used extenders include peahull flour and potato. The optimized level for both the extenders was 5%.

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