

INCORPORATION OF LEGUMES AS NON-MEAT PROTEIN EXTENDERS IN FRESH BEEF SAUSAGES

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Non-meat proteins derived from a variety of plant and animal sources are used extensively as binders and extenders in meat products in order to reduce costs and to provide certain functional properties. Four different types of raw legumes namely soybean, black gram, chickpea and mungbean were evaluated as protein extenders in fresh beef sausages at 25% level of substitution. All the treatments along with control were subjected to chemical, physical and sensory analysis. The results for protein, moisture, fat and pH although differ significantly among the treatments yet lied within acceptable range for all the treatments. The cooking losses and Warner-Bratzler Shear values decreased and juiciness increased for all substitutions. Sensory analysis showed a negative effect of substitution of meat with raw legume flours on the color, flavor, texture, taste and overall acceptability of sausages. Black gram incorporation, however, into sausages showed better organoleptic characteristics and higher acceptability as compared with the other three legumes.

INTRODUCTION

Changing lifestyles have increased demand for processed meat products (Anon, 1996; Fowler, 1997). Sausage is a convenience food and may be defined as any meat that is chopped, seasoned and formed into symmetrical shape by stuffing the mixture of minced meat into casing and tied shut at short intervals (Smith et al, 1982). It is comparatively a new meat product in Pakistan where beef consumption per head is quite low. The people because of convenience, variety, economy and nutritional value consume sausages. These are widely used throughout the world but unfortunately their cost of production especially for developing countries is high. To reduce costs, there is an increasing interest in the use of non-meat proteins, especially plant proteins (Bird, 1974). Various possible sources of vegetable proteins are now being evaluated as protein extenders in comminuted meats. Among these are of vegetable origin such as soybean, black gram, chickpea and those of up graded slaughterhouse wastes (Young, 1980). Of all possible sources, legumes stand a good chance of being used as protein extenders in comminuted meat products, the reasons being their intrinsic cheapness, availability, easy

process ability, indigenous origin and ready acceptability. Legumes also have a good amino acid profile and high protein percentage. Objectives of the present investigation were to reduce the formulation cost of sausages and to study the effect of partial replacement of meat with four different types of legumes on the physical, chemical and sensory characteristics of fresh beef sausages.

MATERIALS AND METHODS

Beef, beef fat, legumes and seasonings were procured from local market. Natural sheep casings of 2022 calibers were obtained from local animal by-product industry. Beef was trimmed, deboned and made free of connective tissues. The four legumes selected for the study were converted into fine flours. Five batches of sausages were prepared using formulations as mentioned in the table (I). All the ingredients were mixed thoroughly using a Hobart Chopper Model 84186, so as to form a uniform emulsion of desired consistency. The meat emulsion was then stuffed into casings by a Hobart sausage stuffer.

Table I. Formulations of sausages

Ingredients	Control T1	Soy bean T2	Black gram T3	Chickpea T4	Mungbean T5
Lean beef	1000	750	750	750	750
Beef fat	250	250	250	250	250
Legume flour	-	250	250	250	250
Ice flakes	100	-	-	-	-
Spices and Seasonings	85.75	85.75	85.75	85.75	85.75

All the five batches were analyzed for moisture, protein and fat contents according to methods described in AOAC, (1990). The pH was determined by the method of Action et

al. (1972). Warner-Bratzler shear force of sausages was also determined using texture meter Salter. Juiciness and cooking losses were determined as stated by Baker et al.

(1969) and Chaudry and Ledward (1988), respectively. For sensory evaluation, sausages were shallow fried for 10 minutes and served hot to a panel of judges who evaluated them for color, flavor, texture, taste, and general acceptability following hedonic scale (Thomas et al., (1973). The data obtained was statistically analyzed according to methods described by Steel and Torrie (1980).

RESULTS AND DISCUSSION

Chemical Analysis

The results of chemical analysis of different samples sausages are shown in Table 2. The moisture range observed for all the five samples was within acceptable range (60.82 – 65.7(1) proposed by National Food Administration Amending ordinance SL V (~986). The results for protein content showed an increase for sausages substituted with soybean (17.65%) and black gram (26.97 %) and a decrease for those substituted with chickpea (13.90 %) and mungbean (13.68 %) when compared with reference sample. The variation found in fat contents of different treatments was closely related to approximate fat content of legumes, the fat being highest in soybean. An increasing trend was observed in pH of substituted sausages as compared to control which was similar to the findings of Terrell et al., (1981).

Physical Analysis

The results of physical analysis of sausages are presented in Table 3. The objective determination of texture (Warner Bratzler shear value) showed a significant decrease in substituted sausages when compared with control. Those incorporating chickpea being the softest of all the treatments. The decrease in

W-8 value could fairly be attributed to the replacement of structural meat proteins with untextured legume proteins.

A considerable decreasing trend was observed in cooking losses of substituted products showing an improvement in emulsion stability (Smith et al., 1973). As softer meat items are often juicier as well (Romans et al., 1994), chickpea substituted sausages were found to be the juiciest among all treatments and the control sample.

Sensory Analysis

Table 4 (Fig. 1) shows the effect of substitution on sensory quality of sausages. Lighter colors were observed in substituted sausages as compared with controls owing to pale colors of legume flours. Raw flavors also resulted from substitution due to uncooked nature of legume flours. Sensory texture was adversely affected by substitution as functional and textural performance of non-meat proteins had already been found to be inferior to meat proteins (Proteus and Quinn, 1979). Taste being the most critical attribute of eating quality, did not show any positive results in substituted sausages. Substitution with raw legume flours had a negative effect on overall acceptance of sausages. However black gram was found to be better meat substitute as compared to the rest. In conclusion, it is suggested that all the four legumes could prove good choices as meat substitutes in sausages. However, the legume starches must either be preheated or texturized mechanically prior to incorporation in the formulation so as to impart better organoleptic characteristics to sausages.

Table 2: Effect of treatments on chemical characteristics

	Moisture (Y.I.)	Protein (%)	Fat (%)	pH
T1	64.89a	14.23c	12.59b	4.82c
T2	60.82b	17.65b	17.5a	6.1b
T3	61.85b	26.97a	6.57c	6.47a
T4	60.88b	13.90c	12.28b	6.05b
T5	65.70a	13.65c	7.15c	6.00b

Table J: Effect of treatments on physical characteristics of sausages

	W-B shear value (kg/inch sq)	Cooking loss (01.,)	Juiciness (%)
T1	0.88a	26.50a	13.78d
T2	0.43b	19.96b	25.5b
T3	0.45b	12.56c	19.42c
T4	0.20c	10.61d	27.16a
T5	0.53b	10.52d	18.6c

Table 4: Effect of treatments on sensory characteristics of sausages

	Color	Flavor	Texture	Taste	General Acceptability
T1	7.4a	7.60a	7.80a	7.4a	7.4a
T2	4.0c	5.60b	6.20b	3.4b	3.4b
T3	7.2a	4.80b	6.40b	6.6a	6.6a
T4	6.20b	4.80b	5.60c	4.4b	4.4b
T5	6.20b	5.20'	5.80	4.2b	4.2b

T1 = All-meat controls
 T2 = Soybean substituted sausages
 T3 = Black gram substituted sausages
 T4 = Chickpea substituted sausages
 T5 = Mungbean substituted sausages

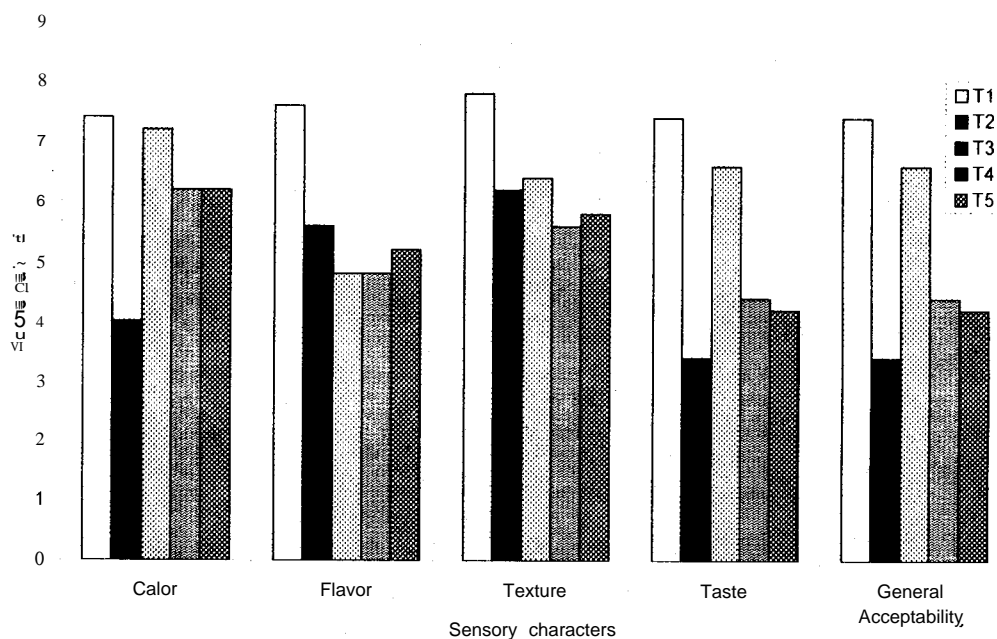


Fig. 1. Effect of treatments on sensory characteristics of sausages

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