

# Sensory Evaluation of Cooked Sausages with Legumes Additive

Ilze Gramatina, Jelena Zagorska, Evita Straumite, and Svetlana Sarvi

**Abstract**—In the meat processing industry the substitution of meat with non-meat ingredients is considered an important strategy for reducing overall production costs. The main purpose of the current research was to evaluate differences in physical-chemical composition of cooked sausage with different legumes additions. Peas (*Pisum sativum*), beans (*Phaseolus vulgaris*) and lentil (*Lens culinaris*) were used in preparation of sausages. The legumes at proportion of 20% of the total weight of meat were added in sausages. The whole ingredients were mixed, filled into casing, compressed, cooked and cooled. After storage the samples were sensory evaluated. The sensory evaluation was carried out using the nine point hedonic scale and line scale. Sausages without legumes flour was used as control sample. The main conclusion of the current research the legumes flour can be successfully used for cooked sausages production.

**Keywords**— Legumes, cooked sausages.

## I. INTRODUCTION

LEGUME seeds are of prime importance in human and animal nutrition due to their high protein content (20–50%). Their protein content is twice the level found in cereal grains and significantly more than the level in conventional root crops [1], [2]. Legumes include peas, beans, lentils, peanuts, and other podded plants that are used as food. Legumes have been cultivated for thousands of years, although many of the varieties of beans and peas that are commonplace today were unknown until relatively recent times. Legumes have played an important role in the traditional diets of many regions throughout the world. It is difficult to think of the cuisines of Asia, India, South America, the Middle East, and Mexico without picturing soybeans, lentils, black beans, chickpeas, and pinto beans, respectively. In contrast, in many Western countries beans play a less significant dietary role. In fact, bean intake has actually declined during the past century in many European countries [3], [4]. The use of plant protein products in food as functional ingredients to improve the stability and texture as well as the nutritional quality of the product or for economic reasons is very extended. Nevertheless, these applications in the food trade are almost limited to proteins from soybean seeds,

whereas other vegetable proteins are less used. Among these are those from lupins (*Lupinus albus* L.), peas (*Pisum sativum* L.) and broad beans (*Vicia faba* L.), that are extensively grown in different parts of the world [1], [5].

The reduction of fat in meat products has drawn greater attention by the meat industry the world over in recent years for health reasons [6]. In the meat processing industry the substitution of meat with non-meat ingredients is considered an important strategy for reducing overall production costs. Non-meat proteins from a variety of plant sources such as soy proteins, buckwheat protein, samh flour, common bean flour and bengal gram, green gram and black gram flours and corn flour have been used as binder and extenders in comminuted meat products. Stability, yield, textural palatability and cost of meat products are the major criteria for non-meat proteins [6], [7]. In recent years legumes have been investigated regarding their potential use in developing new functional foods. Legumes provide energy, dietary fibre, proteins, minerals and vitamins required for human health. They are generally good sources of slow release carbohydrates and are rich in proteins. Inclusion of legumes in the daily diet has many physiological effects in controlling and preventing various metabolic diseases such mellitus, coronary heart diseases and colon cancer [8].

Proteins from legume seeds have been widely studied as regards functional and bioactive properties and one of the sources of plant proteins can be make an attractive alternative to wheat flour as a meat binder for replacement of a portion of the proteins in low-fat meat production [9]–[11]. Plant and animal proteins are used in meat products to perform three basic functions: the first function is fat emulsification, the second is water retention, and the third is formation of structure of meat products [12]. Legume flours are consumed around the world as a nutritious protein source, whose consumption has been shown to reduce low density lipoprotein (LDL)-cholesterol and the risk of acquiring type-2 diabetes [9].

Sensory evaluation – a scientific discipline used to evoke measure, analyze and interpret reactions to those characteristics of foods and materials as they are perceived by the senses of sight, smell, taste, touch and hearing. Sensory evaluation involves the interpretation of the responses by the sensory professional [13]–[15]. Sensory properties are some of the most important factors on consumer liking and preference; thus it is very important to determine factors affecting the product attributes, acceptance and preference especially for foods [16], [17].

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Nowadays legumes (accept soy protein) are not used in meat industry in Latvia therefore the main purpose of the current research was to sensory evaluate the cooked sausages with legumes additives.

## II. MATERIALS AND METHODS

Experiments were carried out in Latvia University of Agriculture (LUA), Faculty of Food Technology (FFT), Department of Food Technology scientific laboratories.

### A. Raw Materials

Such materials were used in these experiments and were obtained from a local market:

1) Legumes–lentil (*Lens culinaris*) from Ltd. “Skaneja”, “Turkish” peas from Ltd. “Skaneja”, beans (*Phaseolus vulgaris*) from Ltd. “Voldemars” and peas (*Pisum sativum*) from Ltd. “Voldemars”;

2) Pork meat from Ltd. “Straumites”;

3) Milk powder from Ltd. “Valmieras piens”;

4) Dehydrated eggs from Ltd. “Balticovo”;

5) Spices – thyme from Ltd. “GAFU”; tarragon from Ltd. “GAFU”; black pepper from Ltd “K&K”; marjoram and garlic powder from Ltd. “Valezs”;

6) Casings were made from viscose material and that was acceptance for preparation of cooked sausages.

In experiments used raw material nutritive and energy value are showed in Table I. Before adding in raw sausages mass each legume was ground in a mill.

TABLE I  
NUTRITIVE AND ENERGY VALUE OF RAW MATERIAL

Raw material	Proteins, g 100 g <sup>-1</sup>	Fats, g 100 <sup>-1</sup>	Carbohydrates, g 100 g <sup>-1</sup>	Energy value, kcal
Pork	16.40	27.80	1.80	316.0
Lentil	23.50	1.40	52.00	314.0
“Turkish” peas	23.10	2.59	27.42	164.0
Beans	21.30	1.60	51.70	259.9
Peas	23.00	1.60	57.70	323.0
Milk powder	-	1.25	-	350.0
Dehydrated eggs	30.00	50.00	0.90	630.0

### B. Preparation of Cooked Sausages with Legumes Additives

20% of meat was substituted with legumes additive. Sausages without legumes additive were used as control sample. The recipes of prepared samples are shown in Table II.

TABLE II  
RECIPE OF SAUSAGES

Ingredients	Raw mass without legumes additive (control sample)		Raw mass with legumes additive	
	Amount, g	Amount, %	Amount, g	Amount, %
Pork	100.00	59.23	80.00	47.38
Legumes flour	-	-	20.00	11.85
Water				40.77
Milk powder				
Dehydrated eggs	68.85	40.77	68.85	
Salt				
Spices				
<b>Total</b>	<b>168.85</b>	<b>100.00</b>	<b>168.85</b>	<b>100.00</b>

Cooked sausages were produced according to the traditional technology (see Figure 1).

The cooked sausages samples were wrapped in polyethylene film and stored in a cooler at 4 °C for 12h before sensory evaluation.

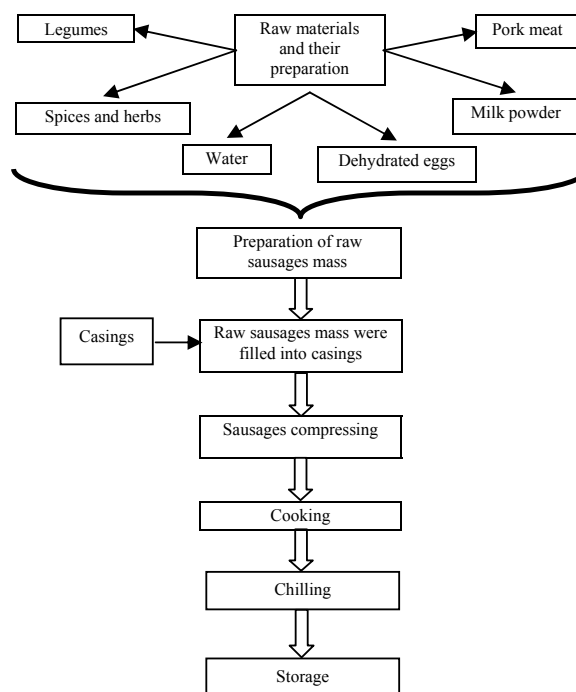


Fig. 1 Cooked sausages production technology

### C. Sensory Evaluation

After preparation cooked sausages samples were sensory evaluated. The sensory evaluation was carried out using the nine point hedonic scale (1 – dislike extremely and 9 – like extremely). The main sensory properties (hardness, aroma, taste, aftertaste, and colour of cooked sausages) were evaluated by the line scale. The nine point hedonic scale was used in order to determine the degree of preference of products [7], where as the line scale was used to estimate the intensity of sensory properties [18]–[20]. Prepared samples were evaluated by trained 30 panellists. The panellists received equally prepared cooked samples and questionnaires, instructions for the evaluation procedure.

### D. Statistical Analysis

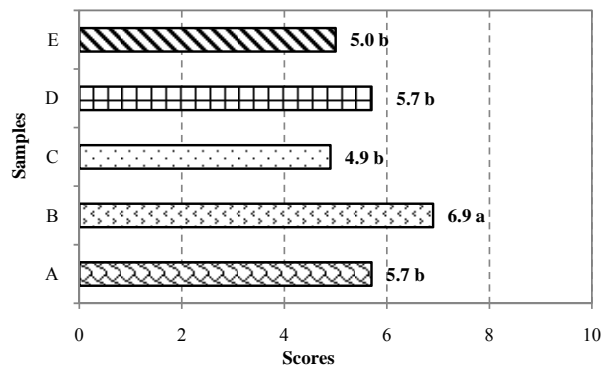
The analysis of variance (ANOVA) and Tukey’s test were used for the analysis of acquired sensory data.

## III. RESULTS AND DISCUSSION

Four cooked sausage samples with legumes additive and control sample (cooked sausage without legumes additive) were prepared for sensory evaluation: A – control sample; B – cooked sausage with lentil additive; C – cooked sausage with “Turkish” peas additive; D – cooked sausage with beans additive; E – cooked sausage with peas additive.

The result of dispersion analysis proves that there are significant difference among the four cooked sausages samples with legumes additives and control sample ( $p < 0.05$ ).

The results of Tukey's test indicate the samples with higher hardness intensity and arrange samples. Average values of hardness intensity of cooked sausage samples with/without legumes additive are seen in Figure 2.



\* – values, marked with the same subscript letters, are not significantly different ( $p > 0.05$ )

Fig. 2 Average values of hardness intensity of cooked sausage samples with/without legumes additive

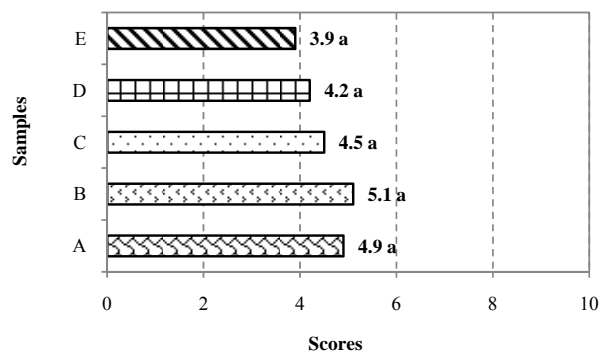
A – control sample; B – cooked sausage with lentil additive; C – cooked sausage with “Turkish” peas additive; D – cooked sausage with beans additive; E – cooked sausage with peas additive.

The results (see Figure 2) show that the sample B (cooked sausage with lentil additive) is harder and differ from other cooked sausage samples. Between other analysed sausage samples the difference was not established. Therefore it can be concluded that it is possible to add legumes to cooked sausages without changes in product hardness.

The results of dispersion analysis show that significant difference between analysed cooked sausage samples with legumes additive and control sample was not found differences ( $p > 0.05$ ).

Average values of legumes aroma intensity of cooked sausages samples with/without legumes additive see in Figure 3.

Obtained results prove, that adding of legumes to raw sausage mass don't impact characteristic cooked sausage taste and don't add specific legumes aroma ( $p > 0.05$ ). More intensive aroma of legumes was detected in sample with lentil additive, but not so intensive in sample with peas additive.

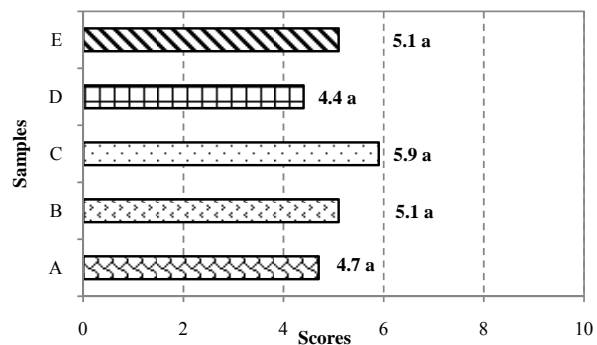


\* – values, marked with the same subscript letters, are not significantly different ( $p > 0.05$ )

Fig. 3 Average values of legumes aroma intensity of cooked sausage samples with/without legumes additive

A – control sample; B – cooked sausage with lentil additive; C – cooked sausage with “Turkish” peas additive; D – cooked sausage with beans additive; E – cooked sausage with peas additive.

The results of dispersion analysis show, that significant differences in meat aroma intensity between samples was not established ( $p > 0.05$ ). Average values of meat aroma intensity of cooked sausage samples with/without legumes additive are given in Figure 4.



\* – values, marked with the same subscript letters, are not significantly different ( $p > 0.05$ )

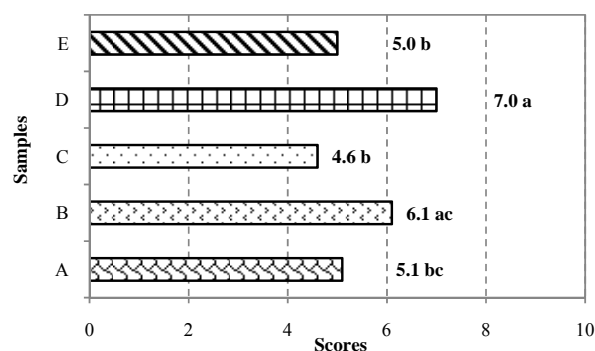
Fig. 4 Average values of meat aroma intensity of cooked sausage samples with/without legumes additive

A – control sample; B – cooked sausage with lentil additive; C – cooked sausage with “Turkish” peas additive; D – cooked sausage with beans additive; E – cooked sausage with peas additive.

Results prove, that meat aroma was not pronounced in all samples. However it is necessary to note, that more intensive meat aroma was detected in C sample (cooked sausage sample with “Turkish” peas additive), also samples B (cooked sausage with lentil additive) and E (cooked sausage with peas additive), but not in control sample.

According dispersion analysis results, significant differences was established between four cooked sausage samples with legumes additive and control sample ( $p < 0.05$ ) in sensory property – legumes taste.

Average values of legumes taste intensity of cooked sausage samples with/without legumes additive are shown in Figure 5.



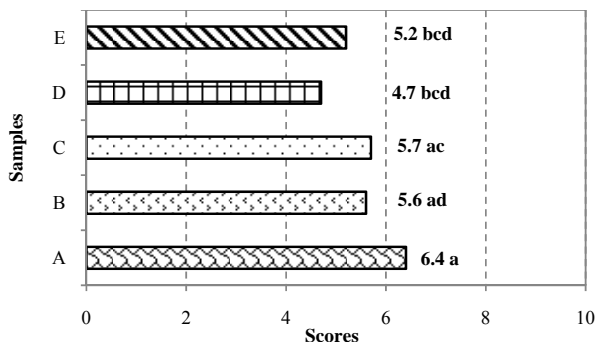
\* – values, marked with the same subscript letters, are not significantly different ( $p > 0.05$ )

Fig. 5 Average values of legumes taste intensity of cooked sausage samples with/without legumes additive

A – control sample; B – cooked sausage with lentil additive; C – cooked sausage with “Turkish” peas additive; D – cooked sausage with beans additive; E – cooked sausage with peas additive.

The obtained results suggested that more intensive legumes taste, comparing to control sample was established in sample D (cooked sausage with beans additive), at the same time it was sample with lower intensity of meat aroma. Sample B (cooked sausage with lentil additive) have similar result. The results can be explained with non pronounced taste of used additives as beans and lentil. Therefore in cooked sausage production the proportion of additive, as beans and legumes should be decreased. The significant difference among samples C (cooked sausage with “Turkish” peas) and E (cooked sausage with peas additive) was not established, the difference was not significant comparing to control sample too.

Average values of meat taste intensity of cooked sausage samples with/without legumes additive are given in Figure 6.



\* – values, marked with the same subscript letters, are not significantly different ( $p > 0.05$ )

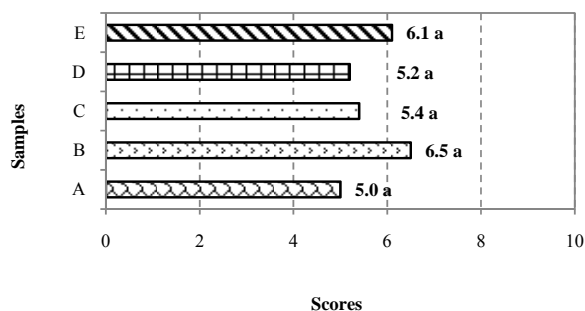
Fig. 6 Average values of meat taste intensity of cooked sausage samples with/without legumes additive

A – control sample; B – cooked sausage with lentil additive; C – cooked sausage with “Turkish” peas additive; D – cooked sausage with beans additive; E – cooked sausage with peas additive.

The results of dispersion analysis show, that significant difference in meat taste intensity was established between analysed samples ( $p < 0.05$ ). The results were expected and most intensive meat taste was detected in control sample. In

samples with legumes additives was decreased content of meat, as result decreased intensity of meat taste.

The results of dispersion analyses prove the fact that between analysed cooked sausage samples with legumes additive and control sample are not significant differences in aftertaste intensity ( $p > 0.05$ ). Average values of aftertaste intensity of cooked sausage samples with/without legumes additive are shown in Figure 7.

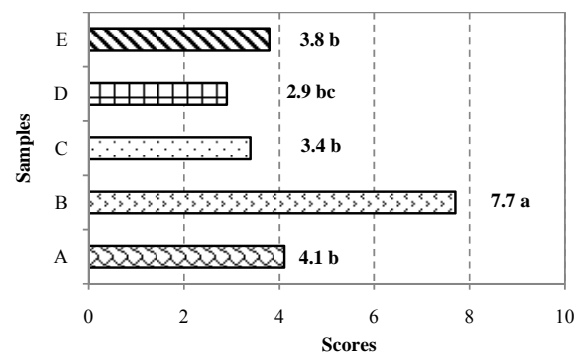


\* – values, marked with the same subscript letters, are not significantly different ( $p > 0.05$ )

Fig. 7 Average values of aftertaste intensity of cooked sausage samples with/without legumes additive

A – control sample; B – cooked sausage with lentil additive; C – cooked sausage with “Turkish” peas additive; D – cooked sausage with beans additive; E – cooked sausage with peas additive.

Obtained results evaluated positively, and it proves fact, that cooked sausage with different legumes don't develop aftertaste of legumes. Dispersion analysis results indicate, that significant difference between analysed samples in intensity of colour was established. Average values of colour intensity of cooked sausage samples with/without legumes additive are given in Figure 8.



\* – values, marked with the same subscript letters, are not significantly different ( $p > 0.05$ )

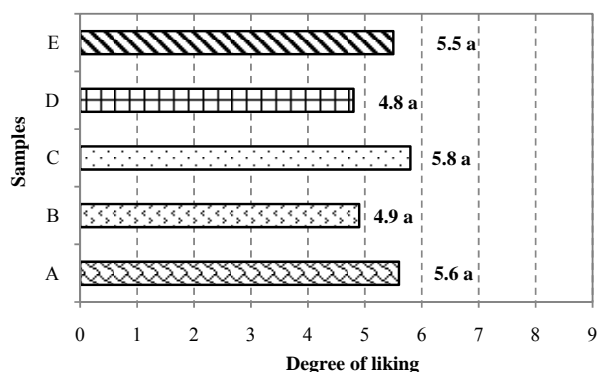
Fig. 8 Average values of colour intensity of cooked sausage samples with/without legumes additive

A – control sample; B – cooked sausage with lentil additive; C – cooked sausage with “Turkish” peas additive; D – cooked sausage with beans additive; E – cooked sausage with peas additive.

The colour of sample B (cooked sausage with lentil additive) was more intensive, comparing with control sample.

Such results are according results obtained measuring colour with colour analyser CIE L\* a\* b\*.

The data of dispersion analyses show that between cooked sausage samples significant difference was not detected ( $p > 0.05$ ), the panellist evaluate all samples equally. Results of hedonic scores for cooked sausage samples with/without legumes additive are given in Figure 9.



\* – values, marked with the same subscript letters, are not significantly different ( $p > 0.05$ )

Fig. 9 Results of hedonic scores for cooked sausages samples with/without legumes additive

A – control sample; B – cooked sausage with lentil additive; C – cooked sausage with “Turkish” peas additive; D – cooked sausage with beans additive; E – cooked sausage with peas additive.

The hedonic scores of cooked sausage samples with legumes additive and control sample are within the scale interval from „neither like nor dislike” to “like slightly” (4.8–5.8).

As significant difference in hedonic score was not established, panellist note two samples: C – cooked sausage with “Turkish” peas additive and E – cooked sausage with peas additive.

#### IV. CONCLUSION

The hedonic evaluation of cooked sausage samples with legumes additive and control sample are within the scale interval from „neither like nor dislike” to “like slightly” (4.8–5.8).

The significant difference between samples was established in the following sensory properties: meat taste and aroma, colour, hardness.

The legumes flour can be successfully used for cooked sausages production.

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