FRI-LB-P-1-BFT(R)-07

APPLICATION OF DIETARY FIBER IN RAW-SMOKED SAUSAGE TYPE "PETROHAN"

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Abstract: Meat is a highly nutritious and versatile food. Its principal components, besides water, are proteins and fats, with asubstantial contribution of vitamins and minerals of a highdegree of bioavailability. However, meat and meat products can be tailored into more "healthier" form by adding ingredients considered beneficial for health or by eliminatingor reducing components that are considered harmful. Fiber is one of the valuable components that can be incorporated in meat products from health point of view. The paper reviews the addition of oat fiber and wheat fiber to raw-smoked sausage type "Petrohan", in amounts of 4% and 8%, respectively. The purpose was to research the general composition and texture properties, and sensory evaluation to assess the influence of this dietary fiber on the quality and palatability of raw-smoked sausages. Results showed that the type and amount of dietary fiber introduced did not significantly influence the general composition. However, the addition of wheat fiber added implied a harder texture. Results of product assessment showed that, aside from sausages with 8% wheat fiber scoring less than 6 points (on a 9-point scale) in terms of overall acceptability, the other groups of raw-smoked sausages scored over 6 points. Judges preferred the sausage groups with 4% added oat and wheat fiber. This study demonstrates that adding fiber to raw-smoked sausages to increase the amount of dietary fiber is feasible.

Keywords: meat products, raw-smoked sausages, dietary fiber, sensory evaluation

INTRODUCTION

Meat is a highly nutritious and versatile food. Its principal components, besides water, are proteins and fats, with a substantial contribution of vitamins and minerals of a high degree of bioavailability. However, meat and meat products can be tailored into more "healthier" form by adding ingredients considered beneficial for health or by eliminating or reducing components that are considered harmful (Buttriss, J. L. and Stokes, C. S. 2008, Bodner, J. M. and Sieg, J. 2009, Jimenez-Colmenero et al. 2001). Fibre is one of the valuable components that can be incorporated in meat products from health point of view. The American Association of Cereal Chemists (AACC) defines dietary fiber as the edible parts of plants or analogous carbohydrates; fiber cannot be digested and absorbed in the small intestine, but can be partially or wholly utilized for fermentation in the large intestine (AACC report, 2001). Based on differences in solubility, dietary fiber could be categorized as water-soluble and water-insoluble. Water-insoluble fiber is often used for preventing and treating colonic diseases, preventing and treating constipation and other related diseases, as

well as regulating body weight. Various types of fibres have been studied either alone or combined with other ingredients for formulation of reduced-fat meat products, mostly ground and restructured products (Ayadi, M. A. et al. 2009, Besbes, S. et al. 2008, Fernandez-Gines et al. 2004)) and meat emulsions (Serdaroglu, M. 2006, Huang, S. C. et al. 2005). Dietary fiber as a functional ingredient can be incorporated with meat products to improve health view of meat products. The addition of dietary fiber to meat products has been successfully used in improving cooking yield, reducing fat contents, and enhancing texture. Various types of dietary fibers have been studied for formulations of meat products such as frankfurters, dry fermented sausages and beef patties (Kim, H.-W. et al.2009, Serdaroglu, M. 2006, Aleson-Carbonell et al. 2005).

Raw-smoked sausages are traditional meat products in Bulgaria. This study experimented with adding different types of dietary fiber to raw-smoked sausages type "Petrohan". Initial evaluation suggested that adding wheat fiber and oat fibers the best results. As a result, this study added different amounts of wheat fiber and oat fiber to raw-smoked sausages, and used analysis of general composition, texture properties and evaluation of preference to assess the influence of added dietary fiber on the quality and palatability of these sausages.

EXPOSITION

Preparation of raw-smoked sausage type "Petrohan".

The sausages were manufactured according to a traditional formula for Petrohan type sausage:

	all sausage, vallallt
I. Raw materials	Mass, kg
1.Beef	30,000
2. Pork half-fat	70,000
Sum:	100,000
II. Salting materials and spices	
1. Salt	2,500
2. Potassium nitrate E 252	0,050
3. Sugar	0,200
4. Black pepper	0,300
5. Cumin	0,500
6. Red pepper sweet	0,400
7. Pumpkin	0,300
8. Pig small intestine \emptyset 26 - 32 mm	131 m
Sum:	4,250
Finished product	65,600 kg

Beef and pork (with a temperature of not higher than -3 to -2oC) are ground to a wolf machine with the desired mesh diameter of the grid. Then the raw materials are mixed together with the spices. The auxiliaries are added thereto and the mixture is cut to obtain a uniform mass. After that, cooking or nitrite salt, sodium nitrite and / or potassium nitrate, spices, flavor enhancers, GDL or bacterial starter culture, the smoke flavor, the colorants and commercial fiber are added. The stirring is continued until a filling temperature of not more than -1 °C is reached. The finished table for raw smoked sausages is filled with a vacuum filling machine. Sausages are formed and drained at 12 °C for 30-40 min. Drying at 15 - 20 °C and curing at a temperature of 18 - 25 °C to obtain a red brown color of the shell. The steamed sausages are dried in air-conditioned chambers at an air temperature of 15-23 °C, relative air humidity of 85-75% until the desired water content of the finished product is reached. Five batches were manufactured: four of them with different kinds (wheat fiber, dietary fiber content 97%; oat fiber, dietary fiber content 96%.) and levels (4 and 8%) of commercialfiber. The batch was manufactured without commercialfiber and was considered as control.

Physicochemical analyses

Moisture content was measured by the weight difference before and after oven drying at 105°C for 16 h. Crude lipid content was measured by drying the sample in a 105°C oven for 6 h and then extracting the lipid with ether in a Soxhlet extractor for 4 h. Crude protein content was measured by the Kjeldahl method (AOAC, 1984). The crude fiber was determined according to the method of Prosky et al. (1988). The water activity was read (Aqua Lab,USA) after equilibration at 25°C. The pH of the raw sausages was measured after homogenization with distilled water at a ration of 1:10 using a pH meter (Denver Instrument, USA).

The texture profile analyses (TPA) indices of sausages were determined using a texture analyzer (Model TA-XT2 Texture Analysis, England). The conditions of texture analyzer were modified by Huang et al. (2005), pre-test speed, 3.0 mm/s; test speed, 1.0 mm/s; post-test speed, 3.0 mm/s; distance, 10.0 mm; time, 5.0 s; trigger type, auto; and trigger force, 10 g. The sensory analysis of sausages were evaluated by 15 untrained assessors selected according to their habits. Sausages were cut into slices 5 mm of thick. Samples were labelled with 3-digit random numbers and served in random order to assessors in individual booths. Assessors were instructed to cleanse their palates with water between samples. A hedonic test was carried out using 9 point scales (9 = like extremely and 1 = dislike extremely) (Meilgaard et al., 1991) in which the assessors evaluated different attributes: appearance, taste, texture, flavor, overall acceptability.

Statistical analysis Data were analysed using SPSS 12.0 for one-way ANOVA. Duncan's new multiple range test was used to resolve the difference among treatment means. A value of p<0.05 was used to indicate significant difference.

RESULTS AND DISCUSSION

Proximate composition of raw-smoked sausage type "Petrohan".

Table 2 shows the chemical composition, water activity, and pH values of raw-smoked sausages with wheat and oat fiber added. The control group had the highest water content, at 56.76%, while the groups with different concentrations of added wheat and oat dietary fiber had water content of 47.98-51.30%, significantly lower than the water content of the control group. The crude fat content of the different groups of sausages was 17.28-23.90%, crude protein content was 13.78-15.26%, and carbohydrate content was 8.29-11.05%. The experimental and control groups did not exhibit significant differences in crude fat content, crude protein content, or carbohydrates (p>0.05). Crude fiber content was 0.04-3.89%, and increased with added dietary fiber. Dietary fiber content was calculated using the original fiber content of the dietary fiber powders (wheat fiber, 97%; oat fiber, 96%), and based on the amount of powder added (4 or 8,0%) and mass lost (8-9%). Using this method of comparison, the dietary fiber content of the control group was 0%.

		different kinds and levels of dietary fiber			
Batch	Control	Oat 4%	Oat 8%	Wheat 4%	Wheat 8%
Moisture, (%)	56.76±1.24 ^a ,*	51.30±0.25 ^b	$48.76 \pm 0.78^{\circ}$	47.98±0.23 ^c	50.29 ± 3.39^{bc}
Crude fat, (%)	17.28 ± 2.04^{a}	23.44±2.33 ^a	23.63±1.77a	23.75±0.64 ^a	23.90±4.77 ^a
Crudeprotein,(%)	$14.94{\pm}0.72^{a}$	13.78±0.27 ^a	13.89 ± 0.77^{a}	15.26±0.39 ^a	13.83±1.51a
Ash, (%)	2.74 ± 0.12^{a}	2.65 ± 0.07^{ab}	2.68±0.01 ^{ab}	2.55 ± 0.01^{b}	$2.64{\pm}0.04^{ab}$
Carbohydrates (%)**	8.29±1.20 ^a	8.84±1.99 ^a	11.05±0.98 ^a	10.47±0.24 ^a	9.35±3.22 ^a
Crude fiber, (%)	0.04 ± 0.01^{e}	1.60 ± 0.29^{d}	$3.50{\pm}0.00^{b}$	2.03 ± 0.12^{c}	3.89 ± 0.16^{a}
Dietary fiber, (%)***	0	3.04	5.87	3.09	5.91
a_{w}	0.943 ± 0.002^{a}	0.941 ± 0.000^{ab}	0.936 ± 0.006^{ab}	0.938 ± 0.001^{ab}	0.941 ± 0.004^{ab}
pH value	6.57 ± 0.02^{a}	6.62 ± 0.05^{a}	6.62 ± 0.01^{a}	6.57 ± 0.04^{a}	6.60 ± 0.03^{a}

Table 2. Chemical composition, water activity and pH value of Petrohan sausages added with

* Means with different superscript letters within the same column are significantly different at p<0.05.

** Carbohydrates (%) = 100%-moisture (%)-crude fat (%)-crude protein (%)-ash (%).

*** Values by calculation. Dietary fiber content: Wheat fiber 97%; Oat fiber 96%.

The water activity of Petrohan sausages is around 0.91, but the type of additives influences water activity. Table 2 shows that the water activity of the various groups was between 0.936-0.943, indicating only minor differences between the groups. The pH values of the various groups were between 6.57-6.62, with no significant difference between the groups (p>0.05). These results are consistent with findings in research literature (Yilmaz, I. 2005, Kerr et al. 2005), indicating that the addition of dietary fiber does not influence the water activity and pH values of dry-fermented sausages. The results described above show that the addition of dietary fiber reduces the water activity of sausages but does not significantly influence other chemical components.

The texture properties of Petrohan sausages

Table 3 shows the results of analysis of texture properties after introducing different dietary fibers to Petrohan sausages.

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Batch	Control	Oat 4%	Oat 8%	Wheat 4%	Wheat 8%
Hardness, g	238.87±31.28 ^c	388.26 ± 26.60^{b}	457.82±88.95 ^b	480.67 ± 7.62^{b}	670.66±24.43 ^a
Springiness	0.68 ± 0.42^{a}	0.69±0.01 ^a	0.65 ± 0.00^{ab}	0.67 ± 0.04^{ab}	$0.64{\pm}0.01^{ab}$
Cohesiveness	0.42 ± 0.03^{ab}	0.46±0.01 ^a	0.41 ± 0.01^{ab}	$0.44{\pm}0.02^{ab}$	$0.44{\pm}0.00^{ab}$
Gumminess,g	99.86±6.57 ^c	176.51±6.75 ^b	189.03 ± 43.0^{b}	208.32 ± 4.57^{b}	293.76±14.06 ^a
Chewiness, g	67.52±8.29 ^c	121.55 ± 4.45^{b}	122.50 ± 27.5^{b}	139.57±13.2 ^b	187.77 ± 4.48^{a}

Table 3. Texture properties of Petrohan sausages added with different kinds and levels of dietary fiber

* Means with different superscript letters within the same column are significantly different at p<0.05.

Hardness was between 238.87 and 670.66; springiness between 0.64 and 0.69; cohesiveness between 0.41-0.46; gumminess between 99.86 and 293.76; chewiness between 67.52 and 187.77. There were significant differences between the groups in terms of texture (p<0.05). The addition of dietary fiber significantly influenced the texture of Petrohan sausages. Desmond and Troy (2003) suggested that of the characteristics of texture, hardness is the most significant factor in influencing consumer preference towards meat products, so this study primarily examined the hardness of Petrohan sausages. The addition of wheat fiber significantly increased the hardness of Petrohan sausages also found that the addition of wheat and oat fibers significantly increased the hardness of meat products. Gumminess and chewiness were determined from the following calculations:gumminess= hardness×cohesiveness; chewiness = hardness×cohesiveness×springiness. Consequently, the resulting gumminess and chewiness of the sausages after the addition of different types of dietary fiber followed the same general trend as the hardness of the sausage.

The sensory properties of Petrohan sausages

Table 4 shows the results of evaluation of preference for the Petrohan sausages. The table shows that the overall scores of the sausage groups with 4% added wheat and oat fiber were 7.5 and 7.67, respectively, higher than the control group.

Table 4. The sensory properties of Petrohan sausages added with different kinds and levels of dietary fiber

Batch	Control	Oat 4%	Oat 8%	Wheat 4%	Wheat 8%
Appearance	5.56 ± 1.58^{bc} ,*	6.83 ± 0.92^{a}	6.72 ± 1.27^{a}	7.06±1.39 ^a	$5.11 \pm 1.53^{\circ}$
Taste	6.89±1.45 ^a	7.33±0.91 ^a	6.56±1.42 ^{ab}	$7.44{\pm}0.98^{a}$	5.78±1.31 ^b
Texture	6.00 ± 1.54^{b}	7.56 ± 0.86^{a}	7.06±1.26 ^{ab}	7.56±1.29 ^a	$5.06 \pm 2.01^{\circ}$
Flavor	6.85±1.53 ^{ab}	7.39±1.04 ^a	6.94±1.51 ^{ab}	7.06±1.21 ^{ab}	$5.44 \pm 1.76^{\circ}$
Overall	6.45 ± 1.33^{bc}	7.67 ± 0.77^{a}	6.78 ± 1.00^{abc}	7.50±1.04 ^{ab}	5.50 ± 1.98^{d}

* Means with different superscript letters within the same column are significantly different at p<0.05.

The sausage groups with added wheat and oat fiber scored approximately 7.0 for taste, texture, and flavor, and were favored most by the judges. The sausage group with 8% added wheat

fiber scored lowest in sensory characteristics (Yang, H.-S. et al. 2007). The appearance and texture scores in particular for this group were only 5.11 and 5.06, respectively. The sausages in this group did not appear tightly packed, and the texture was negatively affected bydetectable particles of powder. These results may be due to the relatively high water and oil retention of wheat fiber as well as its relatively high water insolvency). Wheat fiber is not suitable for addition to Petrohan sausages at the high concentration of 8%. However, the sausage group with 8% added oat fiber scored at least 6 points, indicating no significant difference from the control group (p>0.05). These results may be due to the relatively water holding capacity and oil-holding capacity of oat fiber (Butt, M. S. et al. 2008). Cause the sausage addition with oat fiber was not hard and juicily. In conclusion, aside from the sausage group with 8% added wheat fiber, judges favored the other dietary fibers at concentrations of both 4% and 8%, the more fiber, the better functional.

CONCLUSION

The results described above show that the addition of dietary fiber reduces the water activity of sausages but does not significantly influence other chemical components.

The addition of dietary fiber significantly influenced the texture of Petrohan sausages.

The sausage groups with added wheat and oat fiber scored approximately 7.0 for taste, texture, and flavor, and were favored most by the judges.

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