EFFECT OF A FRUCTOSE POLYMER ON THE SENSORIAL CHARACTERISTICS OF LOW FAT DRY FERMENTED SAUSAGES

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INTRODUCTION

The interest in low calorie diets has led the food industry to develop or modify traditional food products to contain less fat. This food component contributes to flavour, texture, mouthfeel and the overall sensation of lubricity of foods. Therefore, fat reduction by itself can significantly affect the acceptability of the product (Huffman and Egbert, 1990; Giese, 1996), increasing the toughness of meat products (Barbut and Mittal, 1996). Several approaches to reduce the fat content without substantially affecting the texture have been suggested: the use of leaner raw materials and the addition of water or others ingredients as fat-substitutes. In cooked meat products have been assayed several ingredients as differents proteins (soy, maize, whey protein, egg white, wheat and cotton), carbohydrates (starch, pectin, cellulose, gums and maltodextrins) and fat based fat-replacers (emulsifiers and lipid analogs). In general terms, the results obtained have been satisfactory (Keeton, 1992; Jimenez Colmenero, 1996). However, the fat reduction in dry fermented sausages is more difficult because the sustitution of fat by lean meat produce an excesive toughness due to the high water loss ocurring during the ripening.

OBJECTIVE

The objective of this work is determine the effect of a soluble dietetic fiber (SDF) in dry fermented sausages. For this, different batches have been manufactured at which a fructose polymer (powder or in aqueous solution), previously used in cooked meat products, was added. The final aim is to compare such products with those prepared with the fat level currently used by industry.

MATERIAL AND METHODS

Sausages manufacture: Six different batches were prepared. A control batch, prepared according to a conventional formula (batch A) is composed by lean fresh (14%), pork meat (59%), fresh pork backfat (27%); batch B: lean fresh (25%), pork meat (69%) and fresh pork backfat (6%); batch R1: mixture of batch B added with 7.5% of the fructose polymer; batch R2: mixture of batch B added with12% of an aqueous solution of fructose polymer prepared at 55%; batch R3: mixture of batch B added with 12.5% of the fructose polymer; batch R4: mixture of batch B added with 14% of an aqueous solution of fructose polymer prepared at 80%. A commercial mixture of salt and spices (70g/kg) was incorporated in all batches. The final mixtures were stuffed into artificial casings. They were ripened in a laboratory ripening cabinet (Kowell, mod. CC3AFY) programmed for 48 h at 22°C and a relative humidity (RH) of 90%, followed by 20 days at 12°C and 85% RH.

Chemical analysis: Water activity was done with a Decagon CX1 dew point hygometer at 25ºC. pH was done in a homogenate prepared with 1.5 g of sausage and distilled water (10 ml), using a Crison 2001 pHmeter. Fat content was determined according to the method of Hanson and Olley (1963). Protein (Kjeldhal nitrogen), moisture (oven air-drying method) and ash (muffle furnace) were analyzed following AOAC (1990) procedures. Carbohydrates were calculated by difference.

Microbiological analysis: Total viable counts (TVC) were determined on Plate Count Agar (PCA) and *Micrococaceae* on Mannitol Salt Agar (MSA) both incubated at 32°C for 48 h. LAB were enumerated on double layer MRS Agar at pH 5.6 and incubated for 48 h at 32°C. *Enterobacteriaceae* were determined using Violet Red Bile Glucose Agar (VRBGA) incubated at 32°C during 48 h.

Sensorial analysis: Sausages were analyzed by fifteen trained assessors. The evaluations were performed in a laboratory prepare as described by International Standards Organization (ISO) DP 6658. Two analysis were performed: A tringular test in order to know the possible differences between batches and a descriptive test in which trained assessors evaluated different attributes (odour, colour, texture, hardness, juiciness,taste and overall acceptability) using a non-structured scale of 10 cm.

Textural analysis: The Textural Profile Analysis (TPA) test (Bourne, 1978) was used to evaluate sausages using the Stable Micro System Mod. TA.XT 2i/25. The samples (1.5cm high and 2.5 cm diameter) were compressed twice to 50% of their original height. Parameters were the following: hardness (N cm^{-2}) = maximum force required for the first compression (H1); First bite area = total energie required for the first compression (A1); Second bite area = total energy required for the second compression (A2); Springiness (cm) = height that the sample recovered between the end of the first and start of the second compression (S); Cohesiviness = A2/A1; Gumminess = H1 x Cohesiviness; Chewiness = S x Gumminess .

Statistical methods: Statistical analysis were performed using the ANOVA procedure for the analysis of variance.

RESULTS AND DISCUSSION

The evolution of pH and a_w of all batches was similar to the conventional dry fermented sausages (Fernández *et al.*, 1995). Water activity levels ranged between 0.97 at the day 0 and 0.84-0.86 and the end of ripening. pH decrease quickly during the firsts days from 6.0 (day 0) until 4.8 (day 5) maintaining these values until the 21 day.

Similar situation was observed in relation to microbiological counts. TVC and LAB reached values of 10^8-10^9 cfu/g from the second day of ripening. The MSA counts increased from 10^4 cfu/g to 10^5-10^6 cfu/g at the second day and maintained in these values until the end of the ripening. *Enterobacteriaceae* decreased quickly from initial values of 10^3 cfu/g to values lower than 10 cfu/g at the 5-7 day.

Table 1 shows the composition of experimental batches. Results obtained at the end of the ripening were closed to the predicted values.

Results of the triangular test showed significant differences ($P<0.05$) between batch A and the other ones, but did not among low fat experimental sausages.

Table 2 shows the sensorial analysis results. No significant differences for odour, texture and hardness were observed while colour, juiciness and taste were significantly ($P< 0.05$) affected by the batch composition. Colour and taste were similar in all batches excepting in batch R2 that obtained the lowest values. Juiciness of batch A was different from the others due to the high level of fat and its favourable effect on the palatability of these meat produts (Iyengar and Gross, 1991). However, low fat batches were evaluated as acceptable and no differences were observed between batch B and the ones with the polymer. The overall acceptability results indicated that assesors preferred batch A probably due to its higher juiciness, followed by batch B; no significant differences were observed between both batches in relation to this parameter. Sausages manufactured with the polymer were similar to the low fat control (batch B) and differ significantly from batch A.

Texture Profile Analysis (TPA) parameters are listed in Table 3. Low fat batches were harder than the control A and showed significative differences. Springiness and cohesiviness showed differences only in batch R3, in which the lower value was observed. Adhesiviness was increasing according to the polymer concentration; batch R4 reached a similar value to batch A which indicated that high levels of the polymer improve the low fat sausage adhesiviness approaching this sensorial attribute to the commercial products (batch A). No significant differences were observed in relation to the chewiness and gumminess of all batches.

The results obtained in this work indicate that the addition of this fat subtitute not improve sensorial characteristics of low fat sausages probably due to the texture appreciated and described by panellists as "gummy". However, it has been obtained a product enriched in SDF and reduced in fat which could be of interest to be introduced in any hypocaloric diet.

CONCLUSION

It has been obtained a sausage with a fat reduction over 50%, a soluble dietetic fiber content between 7.5-12.5% and a chewiness and gumminess similar to conventional dry fermented sausages (batch A). However, the overall acceptability was worse evaluated due to their lower juiciness.

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Table 1.- Composition experimental batches at the start and at the end of ripening (%)

Batch	Days	SDF*	Water	Protein	Fat	Carbohydrates	Ash	Fat reduction
A	0		62,0	14,9	18,5	1,3	3,3	
	21		36,1	24,0	31,6	3,1	5,2	
B	0		70,4	17,5	7,4	1,4	3,4	
	21		37,0	36,2	16,3	3,5	7,1	48,5
R1	0	7,5	65,7	16,1	6,4	8,6	3,1	
	21		34,6	33,5	11,0	14,9	6,1	65,3
R2	0	6,5	68,5	12,9	6,6	9,3	2,7	
	21		34,5	34,1	14,0	11,6	5,8	55,9
R3	0	12,5	61,4	14,6	6,8	14,2	3,0	
	21		35,5	27,3	11,2	20,9	5,1	64,6
R4	0	11,0	68,1	12,4	6,0	11,4	2,1	
	21		36,7	27,6	12,6	17,6	5,5	60,1

*SDF: soluble dietetic fiber

Table 2.- Effect of fat reduction and fructose polymer addition on sensory attributes of experimental sausages**

Batch	Odor	Color	Texture	Hardness	Juiciness	Taste	Acceptability
A	7.4 a	7.4 a	6.8 a	4.7 a	7.6 a	7.1 a	7.0 a
B	6.4 a	6.1 a,b	6.3 a	5.8 a	6.3 b	6.3 a,b	6.1 a,c
R1	6.7 a	6.5 a,b	5.9 a	4.9 a	5.3 b	5.8 a,b	5.4 b,c
R2	6.2 a	5.7 b	5.8 a	5.2 a	6.2 b	5.5 b	5.4 b,c
R3	7.3 a	7.2 a	5.7 a	4.7 a	6.1 b	7.0 a,b	6.1 b,c
R4	6.4 a	6.7 a,b	5.2 a	4.1 a	6.2 b	6.1 a,b	5.4 b,c

Table 3.- Effect of fat reduction and fructose polymer addition on textural properties of experimental sausages**

Batch	Hardness	Adhesiveness	Springiness	Cohesiveness	Gumminess	Chewiness
A	30.71 a	-1.81 a	0.52 a	0.38 a	11.72 a	6.05 a
B	46.06 b	-0.24 c	0.43 a,b	0.34 a,b	15.50 a	6.60 a
R1	50.25 b	-0.54 c	0.45 a,b	0.36 a,b	18.10 a	8.50 a
R2	47.75 b	-0.73 c	0.42 a,b	0.34 a,b	16.31 a	6.93 a
R3	45.81 b	-1.30 b	0.38 b	0.32 b	14.58 a	5.51 a
R4	48.02 b	-1.93 a	0.49 a	0.33 a,b	15.76 a	7.67 a

**Means in the same column with different letters are significantly different