Inulin-induced fat reduction in lyoner sausages

R. Hadorn*, P. Piccinali, D. Guggisberg & M. Suter
Agroscope Liebefeld-Posieux Research Station ALP, Schwarzenburgstrasse 161, 3003 Berne, Switzerland.
*E-mail: ruedi.hadorn@alp.admin.ch.

Abstract

In comparison to a control (A) consisting of 22% backfat, 15% backfat was replaced in three experimental lyoner sausages (B, C, D) with different sources of inulin, wheat fibre (only D) and ice water. In sausage E, the total amount of 22% backfat was substituted pro-rata by the other constituents of lyoners A. Replacing backfat led to a fat reduction between 43 to 52% and an increase in production costs up to 5%. pH-values and jelly percentage were similar and colour differences hardly visible. Warner-Bratzler total work and fracturability differed significantly between the treatments in the following order: A > E > inulin treatments. In a consumer test, the fat-reduced lyoners were rated as good as the control (A). The additional sensory description by a trained panel revealed that samples showed profiles with significant different aroma (fatty note) and/or texture (firm, crunchy, juicy and sandy notes) characteristics.

Introduction

Due to malnutrition and a lack of exercise, overweight and obesity become a more and more severe problem in Western societies. Meat and meat products contribute about 20% to human fat consumption while fat content is often overestimated in nutrient databases due to recent developments in animal breeding, cuts, preparation and recipes (Gerber, 2006; Honikel, 2006).

Thus, the meat industry is interested in merchandising fat-reduced meat products without neglecting the positive effects of fat on flavour and texture. It has been reported that inulin, a water-soluble fructane with prebiotic characteristics (Rafter et al., 2007), can be used as a fat replacer in sausages (Böhler, 2006; Jánváry, 2006; Nitsch, 2006). It can not be digested in the small intestine, but is degraded by the microbial flora in the large intestine. Its use is limited by flatulence when amounts were more than 4 g per meal.

The aim of the present study was to check different possibilities of using inulin, also combined with wheat fibre (to improve texture), in order to reduce the fat content of cooked sausages by testing the following parameters: sensory characteristics, nutritive value, physico-chemical features and economic aspects.

Material and Methods

Compared to a control (A) consisting of 46% meat (veal, pork), 22% backfat, 10% calf-head rind and 22% ice water, 15% of the backfat was replaced by inulin from different suppliers and in different forms, wheat fibre and additional ice water according to table 1. In E-lyoners the total amount of 22% backfat was substituted pro-rata by the other constituents of lyoners A. Based on the nutrient content of the raw materials, the calculated fat reduction was amounted for 40%.

Table 1. Experimental design and composition of the lyoners

	A	B	C	D	E
Veal V-II [%]	15.0	15.0	15.0	15.0	19.0
Pork P-III [%]	31.0	31.0	31.0	31.0	40.0
Neck fat P-V [%]	12.0	7.0	7.0	7.0	-
Shoulder fat P-VI [%]	10.0	-	-	-	-
Calf-head rind [%]	10.0	10.0	10.0	10.0	13.0
Ice water [%]	22.0	22.0	29.5	31.5	28.0
Inulin gel, supplier 1[1] [%]	-	15.0	-	-	-
Inulin powder, supplier 2 [%]	-	-	7.5	-	-
Inulin powder, supplier 3 [%]	-	-	-	4.5	-
Wheat fibre, supplier 3 [%]	-	-	-	1.0	-
Other ingredients [pro kg]	Nitrite curing salt: 19 g; spices: 4 g; liquid onion: 1 g; phosphate: 3 g; ascorbic acid / sodium ascorbate: 0.5 g				

[1] *The inulin gel was roughen up by a cutter using 7.5% inulin powder (from supplier 1) and 7.5% water*

The production of the lyoner sausages occurred at the Education Centre of the Swiss Meat Industry (ABZ), Spiez, Switzerland. 17 kg of raw material were used for each treatment in order to produce 30 lyoners of 500 g each. The raw material was minced in a cutter in a temperature range from 0 to 15°C. The resulting batter was filled in artificial casings of 50 mm diameter through a vacuum filling machine. The fresh lyoners were cooked at a temperature of 74°C until reaching a core temperature of 69°C. Lyoner sausages were showered by cold water and stored at 2°C until they were tasted.

Sample preparation, analyses of nutrient content and determination of physico-chemical parameters were performed according to Chatelain *et al.* (2007) and Hadorn *et al.* (2008). A hedonic evaluation of the lyoner treatments was carried out by 147 participants of a congress by tasting cold slices (40 g) on a 9-point scale from 1 (= dislike extremely) to 9 (= like extremely). Additionally, a panel of eight trained persons tested the products on different appearance, texture and flavour attributes on a 10-point intensity scale.

Because there was only one repetition per treatment, no statistical analysis were performed for pH, jelly percentage and economics. Physico-chemical parameters were tested by a one-factorial ANOVA ($P \leq 0.05$) using the Bonferroni t-test for testing the treatment means for significance ($P \leq 0.05$). For the hedonic tests, a Friedman-Test ($P \leq 0.05$) was performed after having calculated mean and standard deviation. Statistical analysis for the descriptive sensory tests were performed by a three-factorial ANOVA using product, testing person and repetition as factors, followed by a LSD-test.

Results and discussion

In comparison to the control, fat content was reduced between 43 to 52% in the experimental lyoners (table 2), which was more than the calculated value of 40%. Due to the higher inclusion of ice water, dry matter was lowered in the experimental sausages and protein content was the highest in E-lyoners due to the highest inclusion rate of meat. Supplementation of inulin was followed by an increased content of soluble dietary fibre, whereas wheat-fibre addition was seen in a slightly increased content of crude fibre.

Table 2. Nutrient content [g pro kg fresh matter]

	A	B	C	D	E
Dry matter	371	339	322	339	276
Crude ash	32	31	31	31	34
Crude fat	190	93	108	102	92
Crude protein	131	118	116	116	140
Sugar	3	36	6	28	3
Crude fibre	0	0	0	3	0
Soluble dietary fibre[1]	15	61	61	59	7

[1] *Calculated by difference*

Fracturability and Warner-Bratzler work were the highest in the control lyoners (A) and the lowest in the inulin lyoners (B, C, D), whereas E-lyoners were intermediate (table 3). pH-values were similar for all treatments and jelly percentage was generally below 0.2%. Colour differences were also small and located around the limit of visual perception at $\Delta E = 1$.

Table 3. Physico-chemical and technological parameters

	A	B	C	D	E	Sign.[1]
pH	5.98	5.95	6.02	6.01	6.03	-
Fracturability [N]	13.0^{a}	9.7^{b}	9.0^{b}	9.0^{b}	10.7^{ab}	*
WB total work [mJ]	597^{a}	449^{c}	440^{c}	489^{bc}	551^{ab}	*
Jelly percentage [%]	0.08	0.11	0.14	0.16	0.06	-
L* (lightness)	74.8^{ab}	73.3^{b}	74.4^{ab}	74.9^{a}	73.7^{b}	*
a* (redness)	7.0^{a}	7.2^{a}	6.1^{b}	6.6^{ab}	7.1^{a}	*
b* (yellowness)	10.9	11.3	11.2	11.0	10.8	n.s.
ΔE (colour distance)[2]	0.00	1.57	1.03	0.42	1.11	-

[1] ** = p ≤0.05 (n = 3); n.s. = not signifikant; - = no statistical analysis; significant differences are denoted by different letters (P ≤0.05)*

[2] $\Delta E = \sqrt{2;\ (L^*_X - L^*_A)^2 + (a^*_X - a^*_A)^2 + (b^*_X - b^*_A)^2}$ *(X = treatment)*

From the hedonic test, only treatments C and D differed significantly; no significant differences could be seen related to the control A (figure 1). In general, the lyoners were rated as neither good nor bad. The variability in individual perception was rather high as it is indicated by the large standard deviations.

The additional sensory description by a trained panel revealed that samples showed profiles with significant different aroma (fatty note) and/or texture (firm, crunchy, juicy and sandy notes) characteristics. Control lyoners had salty, fatty and slight soapy notes and a firm and slight sandy texture. D-Lyoners, which were least preferred, were less rose, had a fattier note, were juicier and less firm.

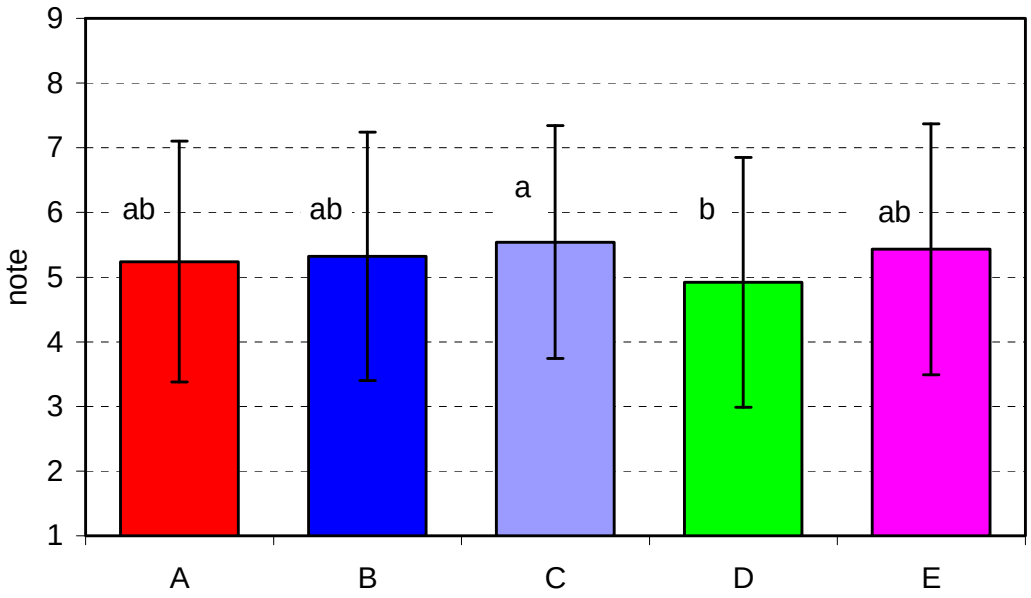

Figure 1. Hedonic evaluation of lyoners (n = 147).
(1 = dislike extremely, 5 = neither like or dislike, 9 = like extremely
significant differences are denoted by different letters (P ≤0.05)

Economical calculations have shown that production costs were increased by 1.4 to 2.6% for the three inulin-treatments (B, C, D) and by 4.8% for the E-lyoners compared to the standard lyoners (A).

Conclusions

It was concluded that a fat reduction of 40% is possible in lyoners without any adverse effects on sensory traits, even though instrumental texture parameters have shown a tendency toward a softer texture and production costs were increased up to 5%.

References

Böhler G., 2006: Wurstwaren und Gesundheitstrend. *Lebensmittel-Industrie* **9/10**, 18-19.

Chatelain Y., Guggisberg D., Dufey P.A., Vergères G. & Hadorn R., 2007: Farbmessung an Fleisch und Fleischerzeugnissen. *ALP science* **507**, Agroscope Liebefeld-Posieux, Bern, pp. 1-23.

Gerber N., 2006: Fleischnährwertdaten im Wandel der Zeit. *7. Symposium Fleisch in der Ernährung - Fleisch und Fett*, 15.11.2006, Proviande, Bern, pp. 21-26.

Hadorn R., Eberhard P., Guggisberg D., Piccinali P. & Schlichtherle-Cerny H., 2008: Effect of fat score on the quality of various meat products. *Meat Science,* doi:10.1016/j.meatsci.2008.03.020.

Honikel K.O., 2006: Fleisch und Fett - von A wie Annahme bis Z wie Zusammensetzung. *7. Symposium Fleisch in der Ernährung - Fleisch und Fett*, 15.11.2006, Proviande, Bern, pp. 5-13.

Jánváry L., 2006: Zusatzstoffe: Fleischerzeugnisse mit Mehrwert – Fettreduzierte, nährwertoptimierte Wursterzeugnisse mit gesundheitlichem Zusatznutzen. *Fleischwirtschaft* **11**, 51-54.

Nitsch P., 2006: Functional Food: Sensorische Qualität bleibt erhalten – Technologie der Verarbeitung von Inulin als „Fettersatzstoff" in Brüh- und Kochwurst. *Fleischwirtschaft* **11**, 41-46.

Rafter J., Bennett M., Caderni G., Clune Y., Hughes R., Karlsson P.C., Klinder A., O'Riordan M., O'Sullivan G.C., Pool-Zobel B., Rechkemmer G., Roller M., Rowland I., Salvadori M., Thijs H., Van Loo J., Watzl B. & Collins J.K., 2007: Dietary synbiotics reduce cancer risk factors in polypectomized and colon cancer patients. *Am. J. Clin. Nutr.* **85**, 488-496.