THE EFFECT OF WHEY PROTEIN-ENRICHED FRACTIONS ON THE PHYSICAL AND SENSORY PROPERTIES OF FRANKFURTERS

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Background

The protein in bovine milk contains approximately 80% casein and 20% whey protein. Beta-lactoglobulin (β-lg) is the major protein present in whey protein. Four β-lactoglobulin (β-lg) enriched fractions were produced using a novel membrane separation technique. These enriched fractions have different mineral contents (sodium, potassium and calcium) and may hold potential as functional ingredients in frankfurters. Considerable commercial interest exists in exploitation of its unique nutritional and functional properties in consumer foods following its fractionation from other whey proteins. Whey proteins have been used in processed meat products to improve their water/fat binding properties without adversely affecting their flavour and textural properties (Hugunin and Lee, 1978). Research is ongoing to improve the functionality of these fractions and it is envisaged that some of the fractions may lead to a reduction in some non-food additives such as phosphate in emulsion-type meat products.

Objectives

The objective of this work was to evaluate the functionality of β-lactoglobulin enriched fractions with varying mineral composition as functional ingredients in frankfurters.

Materials and Methods

Frankfurters were manufactured containing 3% β-lg enriched fractions. Calcium and sodium levels ranged between 17-65 and 63-72mg % (w/w) powder, respectively (Table 1). Frankfurters without added β-lg fractions were used as controls. Frankfurter samples were analysed for percentage moisture, fat and protein (Bostian *et al.*, 1985; Sweeney & Rexroad, 1987). Cookloss and water-holding capacity (WHC) were measured. Texture profile analysis (TPA) was determined using an Instron Model 4464. An eight membered internal panel was used to evaluate the sensory characteristics of frankfurters from each of the treatments (AMSA, 1995). Data was compared using one way-analysis (SAS, 1985).

Results and discussion

Compositional analysis found that the fat level of the frankfurter batter was close to the desired fat level of 30% (Table 1). The addition of the β-lg fractions slightly increased the protein content ($p<0.01$) and reduced the cook loss ($p<0.001$) of the raw batter in comparison to the control (3.98% vs 6.63%). Other researchers have also reported reduced cook losses from frankfurters with added whey protein (Correia *et al.*, 1991; Ker and Toledo, 1992). The fraction with the lowest calcium content reduced the water holding capacity ($p<0.01$). The fraction with the highest mineral level reduced ($p<0.001$) the tenderness of the frankfurter in comparison to the fraction with the lowest mineral level (Table 2). β-lactogloblin fractions had no effect ($p>0.05$) on the juiciness, flavour intensity, other flavours, overall flavour and overall acceptability. All of the fractions increased the TPA value of hardness in comparison to the control ($p<0.001$). Hughes *et al.*, (1998) reported that whey protein significantly increased hardness, gumminess and chewiness but had no effect on springiness or cohesiveness. This was in agreement with previous studies, which show increases in hardness and chewiness of knockwurst sausages with added whey protein but no effect on cohesiveness (Ensor *et al.*, 1987). Beta-lactoglobulin enriched fractions (with their natural mineral content) can be incorporated into frankfurters to improve the cook loss and the tenderness of the product without having a detrimental effect on the flavour and overall acceptability of the product. However, the mineral content of the fractions was not sufficient to improve the overall organoleptic quality of the frankfurter.

Conclusions

This study showed that the mineral composition of the β-lactoglobulin fractions effected cook loss, tenderness and hardness (TPA) of the frankfurters and the addition of the β-lactoglobulin enriched fraction did not affect the organoleptic quality of frankfurters in comparison to the control. This study shows the potential for next generation whey protein fractions and their application in meat products.

Pertinent Literature

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Table 1. Compositional analysis of β-lactoglobulin-enriched fractions

Ingredient	Total protein	Fat	Lactose	Calcium	Potassium	Sodium	Phosphorus (P)
	(%) Autokjel	(%)	by diffusion	mg% w/w powder	mg% w/w powder	mg% w/w powder	mg% w/w powder
β-lg 1	86.04	1.22	1.98	655	97	450	160
β-lg 2	86.44	1.27	1.33	252	33	717	120
β-lg 3	90.39	1.03	2.41	17	<20	63	73
β-lg 4	86.35	1.09	2.89	45	<20	160	153

Table 2. The effect of β- lactoglobulin fractions on the composition, % cook loss and % water holding capacity (WHC) of frankfurters

Whey Protein Type	% Cook loss	% WHC	Raw Composition		
			Moisture (%)	Fat (%)	Protein (%)
Control	6.6^{b}	74.7^{a}	54.89^{a}	29.99^{a}	12.35^{a}
β-lg 1	5.2^{b}	77.3^{a}	$53.67^{b,c}$	29.30^{a}	$13.65^{a,b}$
β-lg 2	3.4^{a}	78.0^{a}	53.43^{c}	29.12^{a}	14.02^{b}
β-lg 3	3.1^{a}	$63.8^{a,b}$	$53.12^{b,c}$	29.20^{a}	13.87^{b}
β-lg 4	4.2^{a}	55.7^{b}	$54.67^{a,b}$	31.74^{a}	13.83^{b}
SED	0.39	3.31	0.18	0.78	0.25

$^{a, b}$ Means in the same row with unlike superscripts are different ($p < 0.001$).

SED: standard error of the difference of the means

Table 3: Influence of β-lactoglobulin fractions on textural and sensoric characteristics of cooked frankfurters

Whey Protein Type	Tenderness	Juiciness	Overall Acceptability	Hardness (N)	Chewiness (N x mm)
Control	$3.95^{a,b}$	4.15a	3.93^{a}	54.9^{a}	248.5^{a}
β-lg 1	$3.89^{a,b}$	3.99^{a}	3.99^{a}	$65.9^{b,c}$	276.0^{b}
β-lg 2	3.58^{b}	3.78^{a}	3.66^{a}	69.3^{c}	293.7^{b}
β-lg 3	$3.91^{a,b}$	4.03^{a}	3.89^{a}	65.7^{b}	239.3^{a}
β-lg 4	4.09^{a}	4.00^{a}	3.70^{a}	$66.0^{b,c}$	237.0^{a}
SED	0.07	0.06	0.08	0.72	4.09

$^{a, b}$ Means in the same row with unlike superscripts are different ($p < 0.05$).

SED: standard error of the difference of the means