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QUALITY CHARACTERISTICS OF PREPARATIONS DERIVED FROM PROTEIN ANIMAL BY-PRODUCTS

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Key words: preparations from animal by-products, quality characteristics, quality of ham, hydrolyzed protein meat flavour

Some chemical, physico-chemical and sensory properties of eignt preparations derived from protein animal by-products were determined. The effect of HPMF preparation upon the quality characteristics of canned hams was studied. It was found that addition of HPMF decresed cooking losses, improved significantly the binding of slices and had not significant effect upon odour and flavour of experimental canned hams.

INTRODUCTION

There is a tendency to make best use of the animal after slaughter because only part of the live weight is eaten as human food. The technology of stable and disposable preparations derived from protein animal by-products is in great progress. According to the technology presented by Grindsted Products A/S [3] and Lensfield Products Ltd. [7] edible animal proteins are derived from fresh pork, rind or from defatted fresh bone by aqueous extraction under pressure. Similar process to Lensfield's one has recently been elaborated in our Institute by Tederko and co-workers [17]. The applied processes cause degradation of protein substances to different extend. The degree of degradation can modify the quality of preparations important from meat processing point of view.

The purpose of our study was comparison of quality of preparations derived from animal by-products. The usefulness of such preparations for canned ham production was determined on the basis of technological trials with one preparation — Hydrolyzed Protein Meat Flavour — HPMF. The effect of added HPMF upon chemical composition and quality characteristics of canned hams was studied.

EXPERIMENTAL

Before technological trials with canned hams the quality of 8 preparations was determined. It was based on chemical composition, including collagen

content, some physico-chemical properties (water binding, pH) and sensory properties. Looking for the reason of different water-binding capacity in 2 preparations the degree of degradation of collagen to hydroxyproline after different time of hydrolysis was determined.

Technological trials were carried out with preparation No. 1 — Hydrolyzed Protein Meat Flavour (HPMF). It is well dispersed in injection brine while Grindsted Protein R-95 sediments in the brine and according to producer recommendation continucus mixing in the brine vessel is necessary [3]. As far as we know HPMF is used in the Netherlands as an ingredient increasing protein level in canned hams. In our experiments carried out in the Institute according to the process applied on industrial scale [16], 4% HPMF preparation was added to injection brine in order to increase the level of protein about 0.5% in canned hams (3 1b). Control trials were prepared without this preparation.

MATERIALS

PREPARATIONS

The following preparations derived from protein animal by-products were studied:

1. Hydrolyzed Protein Meat Flavour produced by Vaessen Schoemaker Chemische Industrie B. V.,
2. Grindsted Protein R-95 produced by Lefdos A/S,
3. 5140 Lencoll Pork produced by Lensfield Products Ltd.,
4. 1130 Lensol Pork — producer as above,
5. Lenfos a-s produced by Tamaco,
6. Lenprotein Soupstock (Beef) — producer as above,
7. Drinde produced by Peter Holm,
8. Edible Bone Protein obtained on Laboratory scale by Tederko and co-workers [17].

RAW MATERIALS

Muscles quadriceps femoris and *M. semimembranosus* selected on the basis of pH at range: 5.7-6.0 were used in trials of canned hams (3 1b).

Quality of canned hams was characterized by determination of cooking losses according to valid standard [8] as well as by sensory and chemical analysis. On the basis of chemical composition of hams P. F. F. — values were calculated to meet the U. S. requirements [2]. To determine the significance of differences between control trials and experimental trials in the way of cooking losses, binding of slices, odour and flavour acceptability of hams Student t-test was used [1].

ANALYTICAL METHODS

The preparations were characterized by:

— organoleptic evaluation of their odour, colour and shape,

— determination of moisrure, nitrogen compounds, ash according to the Polish Standard methods for meat products and caseine [11, 14, 15], fat by Grossfeld's method [6], collagen content calculated on hydroxyproline determination according to the ISO method [4],

— pH of 2% water dispersion (20) with Mera-Tronik N-517 pH-meter,

— water binding capacity according to the standard method for fish protein preparation [19].

Raw materials and canned hams were characterized by:

— determination of water, protein, fat, ash, salt according to the Polish Standard methods for meat products [11, 12, 13, 14, 15],

— sensory evaluation of canned hams according to 5-point scale method [10]. Sensory analysis of canned hams was done by sensory panel (6 to 9 panelists) and obtained results are presented as mean scores.

RESULTS AND DISCUSSION

QUALITY OF PROTEIN PREPARATIONS

Almost all protein preparations were fine, sticky powders except of Lenprotein Soupstock — paste. The intensity of odour was rather small but in some preparations the elements of sticky, hydrolysate and burnt bones were detected. The preparation Drinde containing high amount of fat had slight rancid odour.

Chemical composition of studied preparations is shown in Table 1. As it can

Table 1. Chemical composition of preparations from animal by-products

Preparations	Moisture %	N-compounds (Nx5.55) as protein %	Fat after acid hydrolysis %	Ash %
Hydrolyzed protein meat flavour	7.1	90.9	0.0	2.08
Grindsted protein R-95	0.6	89.3	7.9	1.22
5140 Lencoll pork	3.5	84.0	1.2	5.61
1130' Lensol pork	5.1	88.6	0.6	1.72
Lenfos a-s	6.6	83.3	0.4	4.47
Lenprotein soupstock (beef)	22.7	67.0	0.2	5.22
Drinde	11.6	80.1	5.0	1.48
Edible bone protein	7.0	88.5	0.4	1.81

be seen N-compounds, calculated as protein (n × 5.55), represented more than 80 percent of mass except Lenprotein Soupstock. To know the character of nitrogen compounds the preparations were treated with 6% TCA. It was found that protein was not detected both in HPMF preparation and Grindsted Protein R-95 preparation. Thus, the examined preparations contain products of protein degradation which are not precipitated by TCA. The amount of fat was differentiated from zero and below 1% to 7.9% in Grindsted Protein R-95. High content of fat may cause undesirable change of odour during storage of preparations derived from animal by-products. Ash content was below 2% in half of the preparations and between 4.5% and 5.6% in the others.

Physico-chemical properties of examined preparations are shown in Table 2. The pH values were between 4.94 (Lencoll Pork) and 7.66 (Grindsted Protein R-95). Water binding capacity was differentiated from lack of binding by HPMF

Table 2. Some physico-chemical properties of preparations from animal by-products

Preparations	pH of 2% water dispersion	Water-binding capacity g H_2O/g preparation
Hydrolyzed protein meat flavour	5.99	0.0
Grinsted protein R-95	7.66	6.0
Lencoll pork	4.94	4.7
Lensol-pork	6.29	2.3
Lenfos a-s	6.40	—
Lenprotein soupstock (beef)	6.32	—
Drinde	6.34	4.9
Edible bone protein	6.70	0.0

preparation and Edible Bone Protein obtained on laboratory scale in our Institute [17] till 6 grams of water per 1 gram of preparation by Grindsted Protein R-95. Looking for the reason of different water-binding capacity by HPMF and Grindsted Protein R-95 preparations, the degree of collagen degradation to hydroxyproline after 1h, 5h and 16h hydrolysis was determined in these preparations. The obtained results are shown in Table 3. As it can be seen, at

Table 3. Content (%) of collagen in preparations degraded to hydroxyproline after different time of hydrolysis

Preparations	Time of hydrolysis in 6·N HCl			
	0 h (%)	1 h (%)	5 h (%)	16 h (%)
Hydrolyzed protein meat flavour	0.1	69.1	81.2	77.3
Grindsted protein R-95	10.3	55.5	75.5	74.8

the beginning of hydrolysis higher level of hydrolyzed collagen was detected in Grindsted Protein R-95 preparation than in HPMF preparation. One hour hydrolysis changed the trend which afterwards remained the same after 5h and 16h hydrolisis. 16h hydrolysis in line with ISO method [4], gave almost the same results for both examined preparations but the dofferences between them were found mainly at the beginning and after 1h hydrolysis. The differences in degree of collagen degradation seems to be connected with different values of water binding capacity by a/m preparations (Table 2). But besides the degree of collagen degradation the applied raw materials should be taken into account.

Further analysis concerns amino acids*. The content of assential amino acids in HPMF preparation is shown in Table 4. For comparison the data for other preparations: Grindsted Protein R-95 [3], Edible Bone Protein [17] and results for lean beef [18] are presented. As it can be seen the content of essential amino acids in these three preparations derived from protein animal by-products does not differ too much. The comparison with meat protein (beef) shows that amount of sulphur amino acids, lysine and tyrosine is much lower in preparations. Thus examined preparations cannot be treated from nutrition point of view as full value meat substitute. Very interesting experiments with humans were carried out in Max-Planck Institute by Kofranyi and Jekat [5]. These authors found that the mixture consisting of 16% gelatin-N and 84% muscle-N had higher nutrition value than pure muscle protein.

Table 4. Content of essential amino acids (g/16 gN) in preparations from animal by-products in comparison with lean beef

Essential amino acids	HPMF preparation	Grindsted protein R-95 (3)	Edible bone protein (17)	Lean beef (18)
Cystine	—	0.3	—	1.2
Isoleucine	1.7	1.5	1.8	5.3
Leucine	3.2	2.7	4.3	8.2
Lysine	1.0	4.4	1.2	8.5
Methionine	0.5	1.0	trace	2.9
Phenyloalanine	2.1	2.4	3.0	3.7
Threonine	2.1	2.3	2.8	4.6
Tryptophane	—	0.01	—	1.2
Tyrosine	0.3	0.5	0.7	3.4
Valine	2.6	2.5	3.4	5.4

QUALITY OF EXPERIMENTAL CANNED HAMS

The effect of addition of Hydrolyzed Protein Meat Flavour upon the quality of canned hams is shown in Tables 5, 6, and 7. As it can be seen in Table 5 cooking losses were lower in experimental hams than in control trials. Calculated t-value was not singnificant but it was close to theoretical t-factor at $\alpha = 0.05$. Binding of

Table 5. The effect of HPMF preparation on cooking losses in canned hams (3 lb)

Run number Raw materials	Cooking losses (%)	
	control trial	experimental trial with HPMF addition
M. quadriceps femoris	4.1	3.8
	2.6	4.5
	4.6	4.1
	4.5	3.4
	5.5	4.1
M. semimembranosus	11.4	7.3
	6.6	6.1
	5.9	4.7
	7.4	5.2
M. semimembranosus	6.4	6.4
	10.1	4.9
M. quadriceps femoris	7.5	6.3
	7.1	6.0
n	13	13
mean	6.44%	5.14%
Standard deviation	2.399	1.187
t-Value	1.751	
t-factor	2.064	
$\alpha = 9.05$		

Table 6. The effect of HPMF preparation on binding of slices of canned hams (3 lb)

Binding of slices of canned hams (Mean scores of 6 to 9 panelists)	
Control trial	Experimental trial with HPMF addition
3.3	4.4
4.1	4.1
3.8	4.1
4.3	4.1
3.8	4.1
2.6	4.3
4.2	4.1
3.6	4.1
n 8	8
mean 3.71	4.16
Standard deviation 0.557	0.119
t-Value 2.236	
t-factor $\alpha = 0.05$ 2.145	

Table 7. The effect of HPMF preparation on odour and flavour acceptability of canned hams (3 lb)

	Quality characteristics (mean scores of 6 to 9 panelists)			
	odour acceptability		flavour acceptability	
	control trial	experimental trial with HPMF	control trial	experimental trial with HPMF
	3.0	3.4	3.3	3.4
	3.5	3.4	3.5	3.6
	3.2	3.4	3.3	3.7
	3.8	3.7	3.5	3.8
	3.3	3.4	3.5	3.4
	3.3	3.7	3.2	3.4
	3.2	3.2	3.0	3.2
	3.7	3.7	3.5	3.8
n	8	8	8	8
mean	3.38	3.49	3.35	3.53
Standard deviation	0.271	0.189	0.185	0.237
t-Value	0.963		1.670	
t-factor $\alpha = 0.05$	2.145		2.145	

Table 8. Results of chemical analysis of control (C) and experimental (E) trials of canned hams (3 lb) and calculated P. F. F.-Values

Run number Raw materials	Trial	Water %	Protein %	Fat %	Ash %	NaCl %	Calculated P.F.F.-Values
M. quadriceps femoris	Control	75.4	18.1	2.0	3.99	3.05	18.5
	C	74.9	18.9	1.9	3.95	2.90	19.3
	Experimental	74.1	18.9	1.9	4.32	3.30	19.3
	E	74.5	19.3	1.8	4.14	3.15	19.7
M. semimembranosus	C	73.8	19.1	2.1	3.70	2.70	19.5
	C	72.9	20.4	2.2	3.61	2.85	20.9
	E	72.8	20.4	2.5	4.00	3.05	20.9
	E	72.8	20.9	2.2	3.64	2.80	21.4
M. semimembranosus	C	74.2	19.0	1.9	3.76	2.70	19.4
	C	72.3	19.8	1.3	4.48	3.30	20.1
	E	73.7	20.3	1.1	3.82	2.75	20.5
	E	73.2	19.7	1.9	4.41	3.15	20.1
M. quadriceps femoris	C	73.7	20.6	1.3	3.71	2.60	20.9
	C	74.4	19.2	0.9	4.01	2.85	19.4
	E	74.5	19.9	1.4	3.88	2.70	20.2
	E	74.3	18.9	1.8	3.87	2.70	19.2

19.9% average protein content in control trials

20.4% average protein content in experimental trials

18.5 — U. S. requirements for P. F. F. values in canned ham

slices of hams with added HPMF preparation was significantly better (at level $\alpha = 0.05$) than control hams (Table 6).

Addition of HPMF preparation had not significant influence upon odour and flavour acceptability of canned hams, as it can be seen in Table 7. Mean scores for experimental trials were a little higher than for control trials.

Chemical analysis of hams and calculated PFF-Values are shown in Table 8. In experimental trials with addition of HPMF preparation the average content of protein was 20.4% and in control trials — 19.9%. Calculated PFF-Values meet the U.S. requirements for canned hams with natural juices [2].

CONCLUSIONS

On the basis of obtained results the following conclusions can be drawn:

1. Chemical composition and physico-chemical properties (water binding capacity, pH) of studied preparations derived from protein animal by-products are very differentiated. Water binding capasity of preparations seems to be connected with degree of collagen degradation.

2. The HPMF preparation can not be treated as full value meat substitute because of low amount of essential amino-acids.

3. The addition of HPMF preparation in the amount of 0.5% in canned hams (3 lb) decreased thermal losses, significantly improved binding of slices of hams and had not significant effect upon odour and flavour acceptability of canned hams.

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CHARAKTERYSTYKA JAKOŚCI PREPARATÓW POCHODZENIA BIAŁKOWEGO UZYSKIWANYCH Z MNIEJ CENNYCH SUROWCÓW RZEŹNYCH

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Streszczenie

Przedmiotem badań były preparaty pochodzenia białkowego z mniej cennych surowców rzeźnych. Przebadano 8 preparatów, w tym jeden pochodzenia krajowego uzyskany w skali laboratoryjnej w instytucie przez Tederko i współpracowników. Charakterystyka jakości preparatów obejmowała: organoleptyczną ocenę zapachu i barwy, oznaczenie składu podstawowego i zawartości kolagenu wg metody ISO oraz stopnia jego degradycji po różnym czasie hydrolizy, określenie pH 2% zawiesiny wodnej i zdolności wiązania wody oraz oznaczenie zawartości aminokwasów egzogennych w preparacie HPMF.

Doświadczenia technologiczne wykonano na mięśniach: *M. quadriceps femoris* i *M. semimembranosus* o pH 5,7-6,0. Preparat HPMF dodawano do solanki nastrzykowej, a dalszy proces technologiczny szynek familijnych (3 lb) był zgodny z obowiązującą instrukcją technologiczną. W każdym doświadczeniu produkowano równolegle szynki bez dodatku badanego preparatu — próba kontrolna. Jakość szynek określono na podstawie oceny typu standaryzacyjnego (wyciek cieplny), oceny sensorycznej analizy składu podstawowego, wyliczając na tej podstawie wartości wskaźnika PFF. Stwierdzono duże zróżnicowanie preparatów pod względem składu chemicznego (tab. 1) i właściwości fizykochemicznych: pH i zdolności wiązania wody (tab. 2). Zawartość kolagenu w dwóch preparatach i stopień jego degradacji po różnym czasie hydrolizy przedstawiają dane zawarte w tabeli

3. Badany preparat HPMF, tak jak inne tego typu preparaty, charakteryzuje się niską zawartością niezbędnych aminokwasów (tab. 4). Preparat HPMF dodany w celu podwyższenia zawartości białka w szynkach wpłynął na obniżenie wycieku cieplnego (tyb. 5), poprawił statystycznie istotnie związanie plastrów szynek w stosunku do szynek bez jego dodatku (tab. 6), a także nieco poprawił zapach i smakowitość szynek (tab. 7). Wyniki składu podstawowego szynek i wyliczone na podstawie wartości PFF zamieszczone w tabeli 8 wskazują, że dodatek preparatu MPMF zabezpieczył wymagany na rynku amerykańskim wskaźnik PFF.