Krillfleisch als Protein Substitut in Wurstherstellung

JANINA GRABOWSKA und EDWARD DUNAJSKI

Technical University of Gdańsk, Gdańsk, Poland

Nach dem Kochen, von der Schale mechanisch abgelöst, kann das Krillfleisch als Protein Substitut zur Anfertigung von Brühwurst des Warmblüterfleisches ausgenutzt werden. Beinahe geruch und geschmacklos, von weiss bis hellrosa gefärbt enthält das Krillfleisch durchschnittlich 76,2% Wasser, 21,6% Eiweiss und 1,92% Fett. Die Leistungseigenschaften des betreffenden Materials wurden durch Bezeichnung seines Wasserbindungsvermögen, Protein Löslichkeit, Emulsionsstabilisierung und die Viskosität der Wasserfleischdispersionen charakterisiert. Im Bereich von pH 4,5 bis 8 Krillfleisch besitzt kleines Wässerbindungsvermögen und Quellung, wie auch schwache Fettemulgierung und keine Emulsionsstabilisierung. Löslichkeit des Eiweises in 5%-ger NaCl Lösung ist nicht grösser als 7%. Die Viskosität der Dispersionssysteme Krillfleisch - Wasser ist ungefähr 3 mal niedriger als Rindfleisch-Wasser. In Systemen, in denen Rindfleisch mit Krillfleisch in einer Menge von 20, 30, 50% ausgetauscht wurde Viskosität ist entsprechend um 10, 14, 19% niedriger. Wenn Wasser und Fett im gleichbleibenden Verhältniss zum Eiweiss sind, teilweiser Ersatz von Rind und Schweinefleisch in Brühwerst durch Krillfleisch, in einer Menge bis 13% /umgerechnet auf Eiweiss/ ändert die rheologischen und organoleptischen Eigenschaften des Produktes nicht. Krillfleisch, das nur ganz geringes Wasserbindungsvermiögen und Fettemulgierung besitzt, beinflusst nicht den Gleichgewichtszustand Eiweiss-Wasser-Fett im Moment der Anfertigung des Brühwurstbrät und somit nimmt es keinen Teil in der Bildung der Netzwerk-Strukturen die für rheologiche Eigenschaften der Produkte veranvortlich sind.

Krill meat protein substitute in sausage production

JANINA GRABOWSKA and EDWARD DUNAJSKI

Technological University Politechnika Gdańska, Gdańsk, Poland

Frozen stored krill meat, mechanically peeled after cooking, can be a valuable protein substitute in the production of sausage emulsions from red meats. Lacking almost entirely any taste and smell and being white or light yellow-pink coloured it contains in the everage 76,2% of water, 21,6% of proteins, and 1,9% of fat. The functional properties of such material were evaluated by measuring its water holding capacity, solubility of proteins, emulsion stability, and viscosity of aqueous meat dispersions. At the range of pH 4,5-8 krill meat has negligible water holding, swelling, and emulsifying capacity and does not show any stabilizing effect on emulsion. The solubility of proteins in 5% NaCl solution das not exceed 7%. The viscosity of dispersion systems krill meat-water is about 3 times smaller than that of beef meat-water. The viscosity of systems in which 20, 30 and 50% of beef meat was replaced by krill meat is about 10, 14 and 19% lower respectively. At constant water plus fat to protein ratio a partial replacement of beef or pork in frankfurter sausage formulation by krill meat in amounts up to 13% protein does not induce any changes of the rheological and sensory properties of the product. The addition of krill meat does not affect the protein-water-fat balance because of its small ability of binding water and lipids. Thus krill proteins do not take any part in building of the network structures responsible for the rheological properties of comminuted sausages.

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La viande du Krill comme substitut de protéines pour la production de charcuterie

JANINA GRABOWSKA, EDWARD DUNAJSKI

Université Technique Politechnika Gdańska, Gdańsk, Pologne

La viande du Krill a été separée en façon mecanique d'écaille aprés treatment thermique du krill. Cette viande, peut-être utilisée comme substitut de la viande d'animaux domestiques en production de charcuterie. La viande du Krill est sans goût avec trés faible l'odeur; couleur blanche ou pâle - jaune; teneur moyenne en eau - 76,2%; en protéine 21,6%; et en lipides 1,9%. La propriété fonctionelle du matérial a été determineé par retention d'eau et des matiéres grasses, solubilité des protéines, stabilisation d'émulsion et viscosité de la dispersion aqueuse de la viande. Si rapport d'eau a matiere grasse est constant il est possible incorporer jusqu'au 13% de la viade du krill /calculé sur les protéines/ dans charcuterie /la viande du porc oú la viande du boeuf/ sans les changements appréciables de la caractéristique organoleptique et rhéologique de produits.

Использование мяса криля в качестве белкового компонента при производстве колбасных изделий

Янина Грабовска, Эдвард Дунайски

Гданский Политехнический Институт, Гданск, Польша

После варки целого криля его мясо, механически отделенное от панцыря, может быть использовано в качестве белкового компонента при производстве мясных фаршей.
Мясо криля обладает слабо ощутимым вкусом и запахом, а также цветом от белого по бледнорозового. Оно содержит 76,2% воды, 21,6%белка и 1,9% жира.
Функциональные свойства мяса криля определили при помощи таких показателей как водо-и жиросвязывающая способность, растворимость белков, стабилизация эмульсий, вязкость водных белковых дисперсий. При постоянном соотношений воды и белков в мясном фарше добавленне вместо говяжьего и свиного мяса, мяса криля в количестве до 13% / в пересчете на белок / не вызывает органолептических и реологических изменений колбасных свойств изделей.

Krill as meat protein substitute in sausage production

JANINA GRABOWSKA, EDWARD DUNAJSKI

Technical University, Gdańsk, Poland

Introduction

All over the world intensive researches have been undertaken to find new protein sources of high nutritional value. This paper analyses on ground of physicochemical properties the possibility of using krill meat as protein substitute of red meats.

Methods

The chemical components and the charakteristics of the krill meat were determined as follows: moisture by drying in 105°C, total nitrogen and non-protein nitrogen in trichloroacetic acid extract by the Kjeldahl method, lipids by extraction with chloroform:methanol:water according to Folch /3/ carbohydrates according to Dubois /2/, ash by incinerating a dried sample at about 600°C, protein solubility - in water or 5% solution NaCl at pH 7,5, water holding capacity according to Grau and Hamm /5/ and by sedimentation /7/, swelling ability by mixing with 5% NaCl solution, overnight storing and determining the bound water content as H_2O ccm/1g meat, gel forming ability by measuring the yield limit of homogenized krill meat after heating at 80°C for 15 min., emulsyfying capacity by using a modification /8/ of the Swift /4/ model system, emulsion stability by determining the volume of oil released from the emulsion after 15 min. at 80°C /1/, viscosity by measuring in a rotating viscometer at a shear rate D=0,33 - 145 s^{-1}. The emulsion and dispersions were made in a laboratory silent cutter. Beef, pork and krill meat, water and salt were desintegrated for 5 min., then fat was added and cutting was continued for 10min. The emulsion was stuffed into casing, and after 30 min. setting the sausages were cooked in water at 80°C for 20 min. Constant values $\frac{W}{P}$ and $\frac{T}{B}$ were observed in sausages with and without krill meat. The red meat proteins were substituted by krill meat proteins in amounts from 0 to 60%. The rheological properties of the sausages were characterized by measuring the yield limit and elasticity.

Result and discusion

The meat from frozen krill was obtained using the following procedure /6/:

raw material ⟶ heat treatment ⟶ mechanical treatment ⟶ separation of components ⟶ pure meat / waste

The colour of krill meat is white or yellowish-pink, it is almost without any smell and its taste is neutral with no peculiar attribute.

The chemical composition of krill meat is presented in Table 1. Non protein nitrogen makes scarcely 0,3% of the total amount of nitrogen in meat so the product was practically deprived of nitrogen compounds /peptides, free amino acid etc./ not precipitating in trichloroacetic acid. The content of dried shell in krill meat obtained according to the above procedure does not exceed 0,25%.

Table 1

Chemical composition of krill meat[x/]

content in meat	water	proteins	lipids	carbohydrates	minerals
%	76,2	21,6	1,9	0,016	0,86
by dry mass %	-	88,6	7,8	0,07	3,5

x/ mean values of 9 determinations

The solubility of proteins in water did not exceed 4%, whereas in 5% NaCl solution did not exceed 7% of the total amount of proteins in krill meat /Table 2/.

Table 2

Solubility of krill meat proteins

% of protein soluble in:	water	3,9 ± 0,9
	5% NaCl solution	7,1 ± 0,8

The water binding capacity of krill meat is shown in table 3. During thawing of frozen krill meat the weight losses were only 2 - 4%, and the forced drip amounted to an average of 26% of meat weight.

Table 3

Free water released from krill meat and holding capacity of added water

Free water released %		water retaining index %
unpressed	pressed	
3,2 ± 2,0	26,3 ± 2,5	1,7 ± 5,2

The minced meat did not have any measurable capacity to retain added water measured by the sedimentation method /Table 3/.

The swelling capacity in water was negligible. Even after a long time of contact with water the increase of mass did not exceed 10%. In 2,5% NaCl solution the amount of water absorbed increased to 20%. It did not change at the range of pH 4,5 - 8.

The swelling ability and solubility of protein changed below 4,5 and above 8. No gelling took place when the homogenate of krill meat with NaCl water solution was heated. The peeled denatured muscle protein did not take part in the gelling process. The content of soluble proteins was too small and their gel forming ability was to weak for composing a gel.

The small quantity of soluble proteins present in the meat caused the meat not to loose entirely its fat emulsifying ability. The krill meat had a negligible lipid emulsifying capacity the amount of oil emulsifield under the test conditions was about 80,2±10 cm^3/ 100 mg protein. The amount of oil retained in the emulsion almost in all cases did not exceed 20% of the total amount of oil /Table 4/.

Table 4

Stability of krill meat emulsion

Meat content in water phase emulsion /%/	Stability x/ /%/ oil content in emulsion /%/ 33	50
6	19	15
12	16	15
18	16	15
24	15	18
50	16	17
60	17	14

x/ $S = 100 / 1 - \frac{V_1}{V}/$, where: V_1 - volume of released oil phase /cm^3/
V - total volume oil phase /cm^3/

The viscosity of dispersion system krill meat-water was about 3 times smaller than that of beef meat-water systems /Table 5/.

Table 5

Viscosity of dispersions system of krill and beef meat $D=145\ s^{-1}$

Meat protein content in dispersion system /%/		9	10	13	15
Viscosity of dispersions /Pa · s/	krill	6,8	13,7	15,9	24
	beef	26,2	41,4	50,0	62

The viscosites of dispersions systems in which 20, 30, 50% of beef meat was replaced by krill meat were about 10, 14, 19% lower respectively /Table 6/.

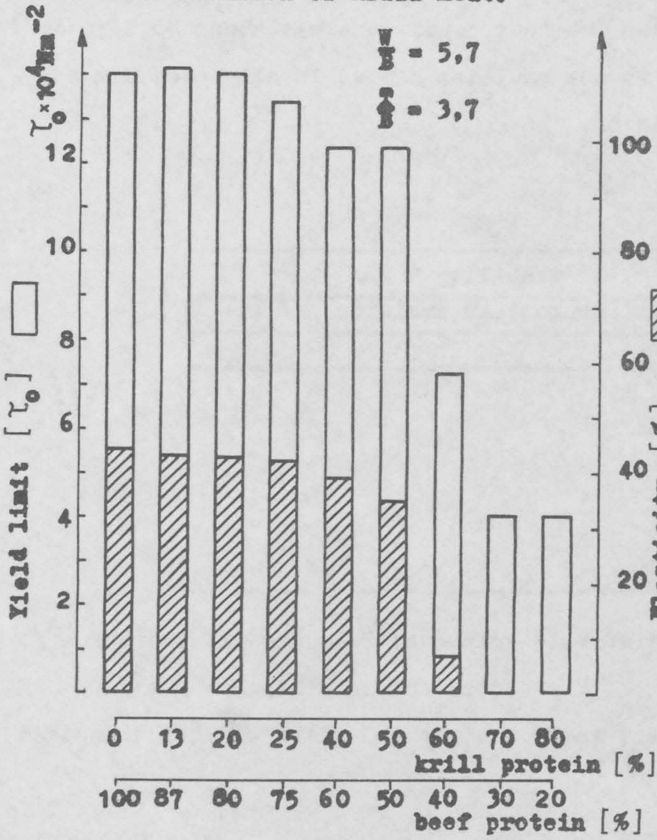
Table 6

Viscosity of water dispersion beef-krill meat

Shear rate s^{-1}	Viscosity /Pa · s/ Content of krill meat protein in the proteins of dispersions /%/ 0	20	30	50
5,4	1110	1050	955	899
16,6	873	335	320	302
46,6	150	135	129	121
81	87	78	74	70
145	50	45	43	40

Content of protein in dispersion 13%

Fig.1. Yield limit and elasticity of the sausages with addition of krill meat.



The results of the experiments indicate that the proteins of krill meat in sausage emulsions do not induce any significant changes in the viscosity of red meat water dispersion.

At constant water and fat to protein ratio a partial replacement of beef or pork in frankfurter sausages by krill meat in amounts up to 13% of protein does not induce any changes of the rheological and sensory properties of the product. After replacement of 20% of proteins a difference in colour and juiciness was visible but there was no real difference in other attributes such as: odour, flavour, yield limit and elasticity. Further increase of the amount of krill meat content in the sausage emulsions changed all attributes to worse.

In sausage emulsions the addition of krill meat does not affect the protein-water-fat balance because of its small ability for binding water and lipids. Besides, krill meat protein does not take any part in building of the network structures responsible for the rheological properties of comminuted sausages.

It seems that krill meat can be a valuable inert protein substitute in the production of sausage emulsions from red meats.

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