UTILIZATION OF SEAL MEAT BY-PRODUCTS

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SUMMARY

Meat from seal (*Phoca groenlandica*) is a rich source of proteins with a well-balanced amino acid composition and contains 5-9% hemoproteins. Presence of large amounts of myoglobin in seal meat is responsible for its very dark colour. Seal meat was mechanically separated; the bone residues contained residual proteins which were treated with proteolytic enzymes. Products so obtained, after dehydration, had a crude protein content of 75-90% and were ivory-white in appearance. Hemin was separated as a by-product in the hydrolyzate preparation. The resultant hemin was subsequently used in the preparation of the cooked cured-meat pigment (CCMP). Application of CCMP to comminuted meats from different species successfully reproduced the typical colour of their nitrite-cured counterparts.

INTRODUCTION

Harp seal (*Phoca groenlandica*) is the major seal species in the southern Labrador and Gulf of St. Lawrence region. The population of harp seal has grown considerably over the last few years in this region and is now estimated anywhere between 5 and 6 million.

A small number of seals ranging between 50,000 and 70,000 are harvested during May-June of each year. Efforts have been under way to fully utilize the resultant carcass meat in preparation of food commodities and value-added products. While the pelt and blubber have been traditionally utilized, seal meat has only been used to a limited extent in the preparation of local foods and production of silage/meal.

In a previous study, we reported that mechanical separation of meat from seal carcass yielded 80-85% protein materials (Shahidi *et al.*, 1990). This mechanically separated seal meat (MSSM) had attractive nutritional qualities as it contained high levels of omega-3 fatty acids, low levels of cholesterol and nucleic acids, and high contents of minerals and vitamins, especially the B vitamins. Residual bone left behind was also found to contain a large amount of proteins (Synowiecki and Shahidi, 1991).

The objectives of the present study were to prepare colourless protein concentrates from seal muscles and to isolate hemin from MSSM or residues in its preparation thereof. Hemin so produced was subsequently used for preparation of the cooked cured-meat pigment (CCMP) followed by testing of its performance in comminuted meat products.

MATERIALS AND METHODS

Beater and bedlamer (< 1 year and 1-4 years, respectively) harp seals (*Phoca groenlandica*) were hunted in the coastal areas of St. Anthony during April of 1991. They were bled, eviscerated, skinned and their subcutaneous fat removed. Carcasses after washing were placed inside plastic bags and stored in containers on ice for about 2 days. Seal meats were separated from carcasses by

mechanical separation using a Poss deboner, Model PDE500 (Poss Limited, Toronto, ON). Mechanically separated seal meat (MSSM) was prepared after removal of most of the residual blubber lipids from the carcasses. The bone residue as well as MSSM samples were vacuum packaged and kept frozen at -20°C for 1 to 6 weeks or at -60°C for longer periods.

Proteins of MSSM or bone residues in the deboning process were subjected to a controlled hydrolysis. The production of hydrolyzates from MSSM or bone residues is outlined in Figure 1. In general, samples were mixed with water at pre-selected ratios. The pH of the mixture was adjusted, generally in the range of 2.4 to 8.5. The temperature was also varied between 25 to 65°C. The hydrolysis was then terminated by a pH change.

Heme pigments were separated as solids and were purified further by dissolution in acetic acid containing 1% NaCl followed by precipitation with the addition of acetone (Figure 2) (Shahidi *et al.*, 1984). The filtrate was further decolourized using activated charcoal and was subsequently dehydrated. Hemin was converted to the cooked cured-meat pigment after its dissolution in a carbonate solution and introduction of a nitrosating agent into the mixture in buffered solutions at room temperature (Shahidi *et al.*, 1985).

RESULTS AND DISCUSSION

The yield of hydrolysis in all cases examined was calculated as percentage of the ratio of nitrogen in solution after hydrolysis to that in the starting material. Yields of 70-80% were obtained after a 2 h period of hydrolysis. Proximate composition and colour parameters of typical preparations are provided in Table 1.

The ivory-white coloured protein products had an amino acid profile similar to the starting MSSM (results not shown). Furthermore, products so obtained possessed excellent functional properties as exhibited in their moisture retention, fat absorption and emulsification properties. When added to formulated and comminuted meat products, enhancement of the cook yield of the final products was noticed.

In preparation of decolourized protein products, converted to the cooked cured-meat pigment (CCMP) under optimal conditions (Shahidi *et al.*, 1985). The resultant pigment upon application to comminuted seal meat as well as pork and beef and subsequent heat processing reproduced the colour of their nitrite-cured counterparts (Table 2). Further research in utilization of seal proteins and other by-products in neutraceutical applications is in progress and results will be communicated elsewhere.

ACKNOWLEDGEMENTS

Financial assistance for the Newfoundland Department of Fisheries, though a NIFDA grant is appreciated.

REFERENCES

SHAHIDI F., RUBIN L.J., DIOSADY L.L., CHEW V., WOOD D.F., 1984. Preparation of dinitrosyl ferrohemochrome from hemin and sodium nitrite. Can. Inst. Food Sci. Technol. J., 17, 33-37.

SHAHIDI F., RUBIN L.J., DIOSADY L.L., WOOD D.F., 1985. Preparation of the cooked cured-meat pigment, dinitrosyl ferrohemochrome, hemin and nitric oxide. J. Food Sci., 50, 272-273.

SHAHIDI F., SYNOWIECKI J., NACZK M., 1990. Seal meat a potential source of muscle food: chemical composition, essential amino acids and colour characteristics. Can. J. Food Sci. Technol. J., 23, 137-139.

SYNOWIECKI J., SHAHIDI F., 1991. Lipid and pigment extraction from mechanically separated seal meat. J. Food Sci., 56, 1295-1297.

Table 1. Proximate composition and colour parameters of seal protein preparations.[a]

Specification		Content/Value
Moisture	, %	6.15±0.05
N x 6.25	, % dwb	83.38±0.25
Lipids	, % dwb	2.14±0.05
Minerals	, % dwb	5.67±0.11
Residues	, % dwb	8.81
Hunter **L**		86.66±0.15
Hunter **a**		0.20±0.05
Hunter **b**		19.73±0.15

[a]Residues were calculated by difference. Hunter values for decolourized materials were **L** = 90.50±0.43, **a** = -0.23±0.10, and **b** = 13.43±0.30, dwb = dry weight basis.

Table 2. Effect of cooked cured-meat pigment (CCMP) and sodium nitrite on colour characteristics of muscle tissues.

Species	Additive (ppm)	Hunter Values		
		L	**a**	**b**
Pork	$NaNO_2$ (156)	58.3±0.2	12.0±0.1	9.1±0.2
	CCMP (8)	57.9±0.2	12.1±0.2	9.0±0.2
Beef	$NaNO_2$ (156)	48.1±0.2	16.8±0.3	8.8±0.2
	CCMP (24)	46.9±0.5	15.9±0.1	8.7±0.1
Seal	$NaNO_2$ (156)	24.0±0.2	16.9±0.3	7.5±0.2
	CCMP (36)	24.9±0.5	19.1±0.2	8.0±0.1

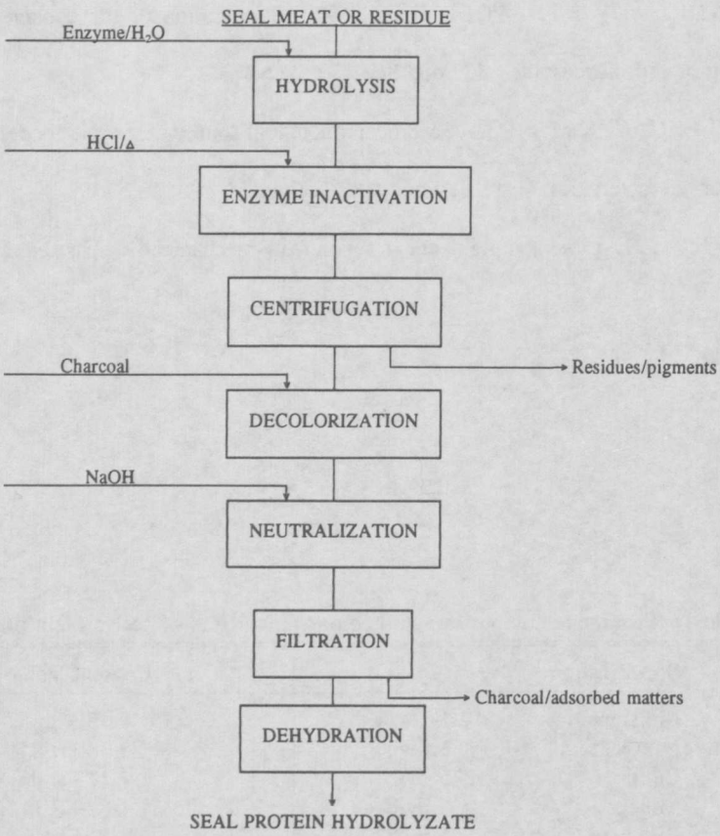

Figure 1. Flow diagram for preparation of seal protein hydrolyzate.

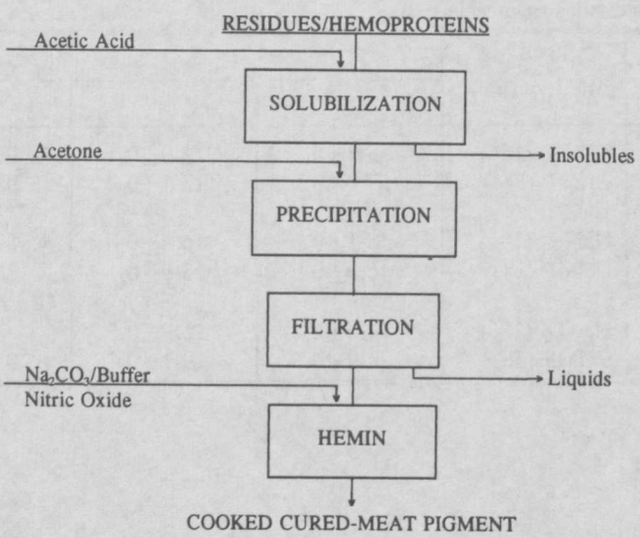

Figure 2. Flow diagram for preparation of cooked cured-meat pigment from hemoproteins in bone residues.