EXTRACTION AND CHARACTERIZATION OF PROTEINS FROM FIVE DIFFERENT INSECTS

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Abstract – More than a thousand insect species are used as human food. However, it is also possible to extract the proteins from insects for further use in food products. The aim of this study is to extract proteins from insects, namely the Yellow mealworm (Tenebrio molitor), the Super mealworm (Zophobas morio), the Lesser mealworm (Alphitobius diaperinus), crickets (Acheta domesticus) and cockroach (Blaptica dubia), in order to characterize the obtained protein fractions and to establish their functional properties. This research mainly consists of three phases: 1) protein extraction & purification, 2) protein characterization, and 3) protein functionality. In conclusion, the insect species studied have potential to be used in foods due to: 1) absolute protein levels; 2) protein quality; 3) ability of forming gels.

Key Words – Insect proteins, Novel meat source, Protein quality

I. INTRODUCTION

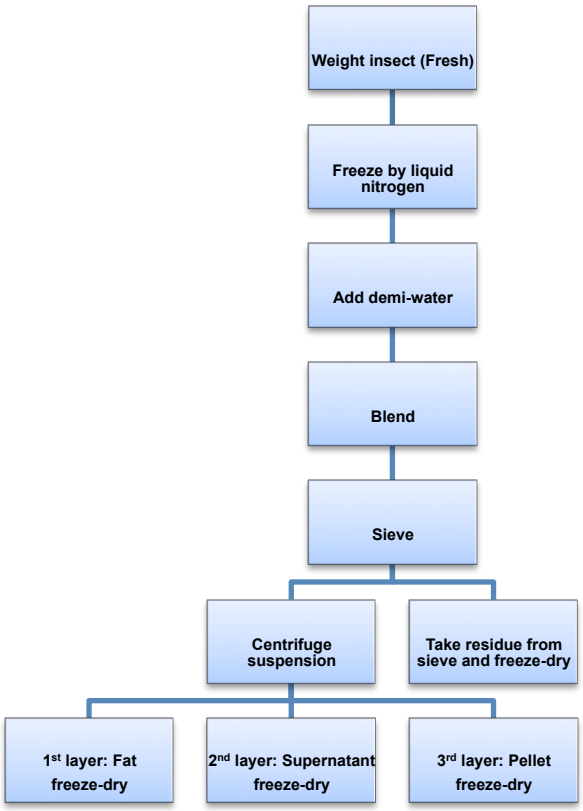
Many insect species are consumed in Africa, Asia and Latin America. More than a thousand insect species are used as human food [2]. Insect products can be consumed as different types of food, such as cocktail, snack, lollipops, and dessert.

For developed countries, insects are now seriously considered as an alternative and additional source of protein, which will be helpful in view of an increasing world population and the environmental problems caused by conventional cattle.

Whole insects are consumed as egg, larvae, pupae or adult. However, it is also possible to extract proteins from insects for further use in food products. In view of consumer acceptance, this is particularly relevant for countries with no habit of consuming insects, such as Europe and North America [2].

II. MATERIALS AND METHODS

The extraction procedure is shown in figure 1. First, fresh insects were frozen by liquid nitrogen. After adding demineralized water and blending, the insect suspension obtained was sieved and a suspension and a residue were collected. After centrifugation, three fractions were obtained from the filtrate: supernatant, pellet, and fat.



The supernatant and pellet fractions are characterized in terms of protein content, molecular weight, iso-electric point, etc. Further on, these fractions will be characterized on functional properties, such as gelation, emulsification and foaming properties.

III. RESULTS AND DISCUSSION

A mass balance was built up based on protein content in residue, pellet, and supernatant fractions. The amount of protein in fractions was calculated based on protein content determined by Dumas and dry matter of the protein fractions.

Table 1: Protein contents of fractions in total fresh insects (g protein/100 g fresh insect) and in total proteins (%)

Insect fractions	Protein contents in total insects g protein/100 g insect	Protein of fractions in total proteins %
Mealworm supernatant	4.4	22.3
Mealworm pellet	6.4	32.5
Mealworm residue	8.9	45.2
Mealworm total protein	19.7	100
Buffalo supernatant	3.5	20.0
Buffalo pellet	6.6	37.7
Buffalo residue	7.4	42.3
Buffalo total protein	17.5	100
Morio supernatant	3.3	19.6
Morio pellet	7.5	44.7
Morio residue	6.0	35.7
Morio total protein	16.8	100
Cockroach supernatant	3.4	19.9
Cockroach pellet	6.3	36.8
Cockroach residue	7.4	43.3
Cockroach total protein	17.1	100
Cricket supernatant	3.2	19.4
Cricket pellet	6.2	37.6
Cricket residue	7.1	43.0
Cricket total protein	16.5	100

The two fractions that the pellet contained proteins and the residue contained of proteins were higher than that in the supernatant for all five types of insects. Further, amount of proteins in the residue was higher than that in the pellet, except for *Z. morio* residue.

Moreover, photographs were taken immediately after processing the supernatant solutions at room temperature (not shown here). They show that the colour of the supernatants from those five types of insects was clearly different. *B. dubia* had the lightest colour (light yellow) and *T. molitor* had the darkest colour (dark brown) among all insect supernatant solutions. The colour of *A.diaperinus, Z.morio and A.domesticus* supernatant solutions was comparable. This observation indicated that chemical reactions took place during processing.

In this study, we also characterized purified protein fractions from insects in terms of amino acid composition, molecular weight, iso-electric point, heat stability etc.

IV. CONCLUSION

1. Three protein fractions were obtained from insects: supernatant, pellet and residue.
2. Protein contents in insect pellet and residue were higher than those in supernatant;
3. Molecular distribution of all insect supernatant proteins ranged below 97 kDa;
4. Molecular distribution of all insect pellet proteins were ranging from 14.5 kDa to 200 kDa.

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