Rapeseed Protein Extraction Process for Aquafeed Use

Halime Adem[1], Ralf Peter Tressel[2], Frank Pudel[2], Lothar Mörl[3]
[1]Gesellschaft für Marine Aquakultur mbH, Büsum, Germany
[2]Pilot Pflanzenöltechnologie Magdeburg e. V., Magdeburg, Germany
[3]Otto-von-Guericke-Universität Magdeburg, Institut für Apparate- und Umwelttechnik, Magdeburg, Germany

Motivation

As increasingly important source of fish available for human consumption, aquaculture is growing more rapidly than all other animal food producing sectors. But the worldwide supply of fishmeal as main protein ingredient for fish diets will be not able to cover the needs of the expected future expansion of global aquaculture. Its future is depending on the supply of sufficient fish fodder of high quality. The research has focused on the fishmeal replacement by oilseed meals. A useful protein source from the by-products of rapeseed oil production, cake or meal, has been suggested as an alternative to fishmeal for aquafeed use. They have relatively high protein content, which is distinguished by a well-balanced amino-acid composition and a high biological value. On the other side, there are some antinutritional factors like glucosinolates, phenolic compounds (tannins and sinapine), phytate and high levels of fibres which have to be removed or minimized before rapeseed cake or meal to be used as a potential protein source for aquafeed.

Objective

The aim of this work is to obtain a rapeseed protein concentrate that could be fed to rainbow trout (Oncorhinchus mykiss), turbot (Psetta maxima) and other species. Currently there is no commercial production of rapeseed protein concentrate. Therefore suitable extraction procedures for the production of rapeseed protein fractions were investigated. The extraction conditions of both main storage protein components cruciferin (12 S globulin) and napin (2 S albumin) were observed. In small pilot scale different rapeseed protein substrates were produced like concentrates (> 60 % protein) as well as globulin and albumin rich fractions.

Materials and methods

Figure 1 represents a process flowsheet of the small pilot scale processing procedures used to produce the rapeseed protein products. The variety of rapeseed “Lorenz” was used in this investigation. The glucosinolate degrading enzyme myrosinase in the seeds was inactivated by heat treatment. The meal for protein isolation was prepared by pressing and hexane extraction. To avoid protein damage during the desolventizing/toasting step, which is the most critical processing step, an innovative gentle meal processing by using a fluidized bed desolventizer was utilized. In order to reduce the antinutritional ingredients the oil free meal was ethanolic extracted. Rapeseed protein fractions were prepared by two-step aqueous extraction procedure, combined with ultrafiltration process to concentrate and purify the proteins, and followed by spray drying.

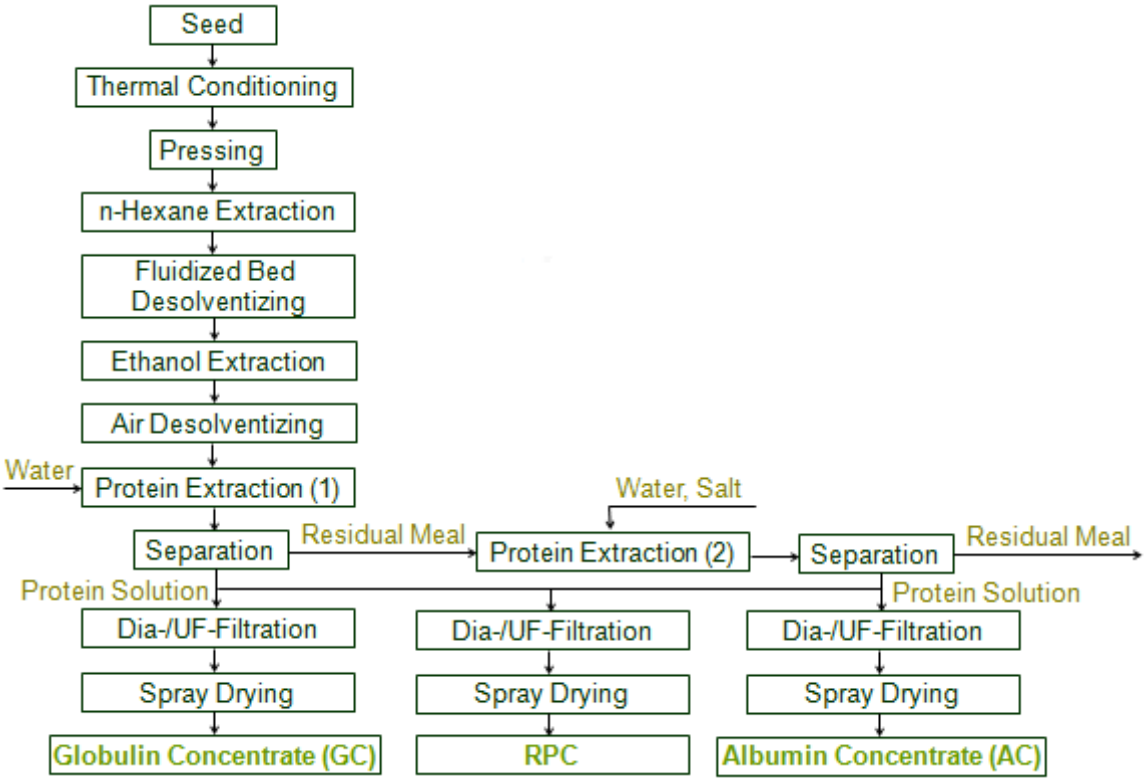

Figure 1: Process scheme for production of rapeseed protein concentrate

The molecular weight profile of the extracted rapeseed concentrates is shown in the Figure 2. The electrophoretic analysis revealed that the cruciferin rich protein (12 S globulin) was obtained by the first extraction and respectively by the second: napin rich protein (2 S albumin). The molecular weights of 32-29, 24-21 KDa for cruciferin subunits and 14-10 KDa for napin subunits were observed in this samples.

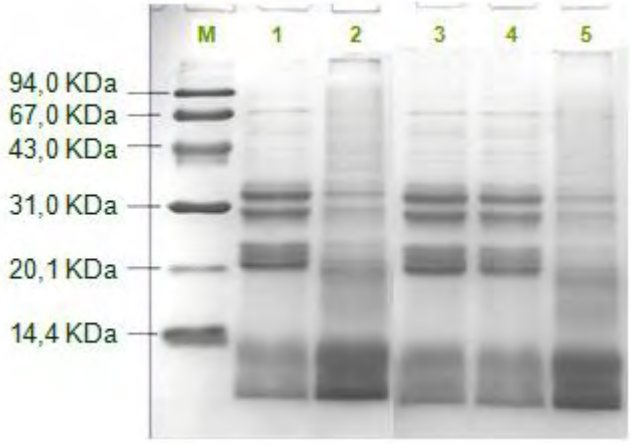

Figure 2: SDS–PAGE in reducing conditions of fractions: (1), (3) and (4) protein fraction of first extraction; (2) and (5) protein fraction of second extraction

Results

By variation of the processing parameters the contents of antinutritive substances and the process efficiency were adjusted. Figure 3 shows the lowering of antinutritive substances by processing of rapeseed into protein concentrate (RPC). The reduction of the antinutritive compounds provides a successful replacement of fishmeal without negative effects on growth performance and health status of fishes. The nutrient content results are given in Figure 4. From the nutritional point of view RPC can be compared with fishmeal protein.

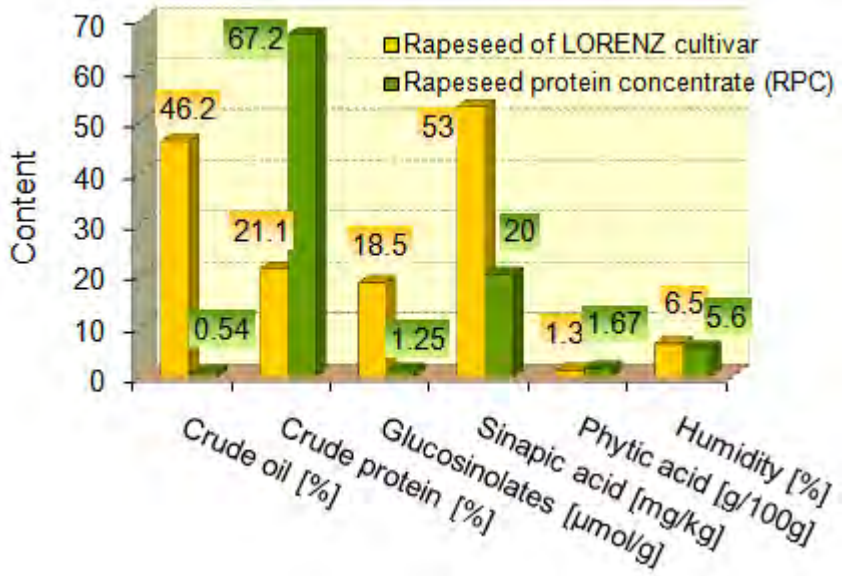

Figure 3: Composition of rapeseed and RPC

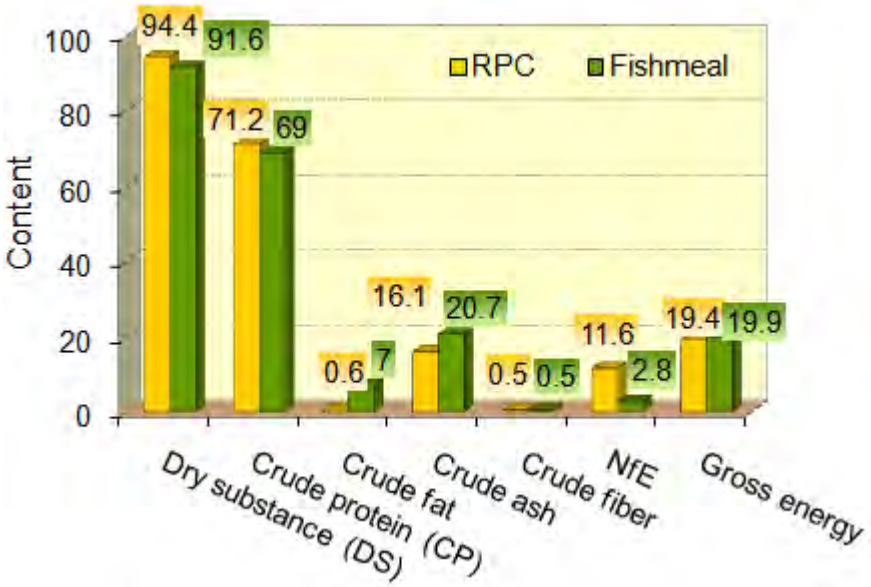

Figure 4: Nutrients (%DS) in RPC and fishmeal

The results of the study of the amino acid content of fishmeal, rapeseed protein concentrate, globulin concentrate and albumin concentrate are presented in Table 1. The rapeseed protein substrates are excellent source of all essential amino acids. They have amino acid levels equal to or greater than fishmeal with the exception of methionine (by the GC and AC) and lysine (by the GC). The amino acid profile of rapeseed protein products reflects well the fish amino acid needs which could imply higher substitution levels.

Table 1: Essential amino acids (g/100g CP) in fishmeal, RPC, GC and AC

Amino acids	Fishmeal	RPC	GC	AC
Arginine	5.84	6.78	6,24	6,50
Histidine	2.00	3.86	2,62	3,28
Isoleucine	3.62	3.80	3,87	4,00
Leucine	6.45	7.57	7,04	7,55
Lysine	6.55	7.87	5,07	6,95
Methionine	2.36	2.36	2,02	1,86
Phenylalanine	3.52	3.60	4,16	3,89
Threonine	3.90	4.17	4,20	4,24
Valine	4.45	5.15	5,00	5,31

Conclusions

The investigated rapeseed protein extraction process provides rapeseed concentrates with high nutritional value and low value of antinutritive factors. Therefore, they are very attractive as an alternative protein source in aquaculture feed. In regard to well-balanced amino acid composition, rapeseed protein is appropriate for aquaculture feeds. The produced rapeseed protein fractions were delivered to investigate the effectiveness of these oilseed proteins as alternatives to fishmeal. The rapeseed protein products were evaluated as protein sources in diets for rainbow trout, turbot and other species. The next point of investigation is to optimize the production process of rapeseed protein isolate and to study its potential as fish feed ingredient.

Acknowledgements

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References

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