



AU9340307

**(12) PATENT ABRIDGMENT (11) Document No. AU-B-40307/93**  
**(19) AUSTRALIAN PATENT OFFICE (10) Acceptance No. 673357**

- (54) Title  
**METHOD FOR OBTAINING HIGH-QUALITY PROTEIN PRODUCTS FROM WHEY**
- International Patent Classification(s)  
(51)<sup>s</sup> **A23J 001/20**
- (21) Application No. : **40307/93** (22) Application Date : **29.04.93**
- (87) PCT Publication Number : **WO93/21781**
- (30) Priority Data
- |                |                 |                  |
|----------------|-----------------|------------------|
| (31) Number    | (32) Date       | (33) Country     |
| <b>9201435</b> | <b>07.05.92</b> | <b>SE SWEDEN</b> |
- (43) Publication Date : **29.11.93**
- (44) Publication Date of Accepted Application : **07.11.96**
- (71) Applicant(s)  
**TETRA LAVAL HOLDINGS & FINANCE S.A.**
- (72) Inventor(s)  
**JOHN JENSEN; PETER HENRIK LARSEN**
- (74) Attorney or Agent  
**WATERMARK PATENT & TRADEMARK ATTORNEYS , Locked Bag 5, HAWTHORN VIC 3122**
- (56) Prior Art Documents  
**AU 638439 46701/89 A23J 1/20 A23K 1/16 A23L 1/30**
- (57) Claim


1. Method of obtaining high quality products from whey, characterized in that whey is subjected to a cross flow filtration in a microfilter, at which supplied whey and retentate are brought to circulate in a circulation path on one side of the membrane area of the microfilter, while whey which passed the membrane surface (permeate) is circulating in a second circulation path on the other side of the membrane area, in such a way that the pressure drop over the whole membrane area is kept constant and the pressure drop over the membrane area is below 0.8 bar at which there is obtained a fractionation of milk serum protein in such a way that denatured milk serum protein and fat is retained in the retentate while undenatured milk serum protein passes the membrane and is present in the permeate, at which after an end treatment of the permeate there is obtained a whey protein product rich in  $\alpha$ -lactalbumin and  $\beta$ -lactoglobulin but with a low fat content.

OPI DATE 29/11/93 APPLN. ID 40307/93  
AOJP DATE 10/02/94 PCT NUMBER PCT/SE93/00378



AU9340307

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

<p>(51) International Patent Classification<sup>5</sup> : <b>A23J 1/20</b></p>	<p><b>A1</b></p>	<p>(11) International Publication Number: <b>WO 93/21781</b> (43) International Publication Date: 11 November 1993 (11.11.93)</p>
<p>(21) International Application Number: PCT SE93 00378 (22) International Filing Date: 29 April 1993 (29.04.93) (30) Priority data: 9201435-6      7 May 1992 (07.05.92)      SE (71) Applicant (for all designated States except US): <del>ALFA LAVAL FOOD ENGINEERING AB (SE-SE), Box 64, S-221 00 Lund (SE)</del> (72) Inventors; and (75) Inventors/Applicants (for US only): JENSEN, John (DK DK); Algade 9, Grundfor, DK-8382 Hinnerup (DK). LARSEN, Peter, Henrik (DK DK); Junivej 38A, DK-8210 Aarhus V (DK). (74) Agent: CLIVEMO, Ingemar; Alfa Laval AB, S-147 80 Tumba (SE). (71) Tetra Laval Holdings &amp; Finance S.A. Avenue General Guisan 70, CH 1001 Yverdon Switzerland</p>		<p>(81) Designated States: AU, CA, JP, NZ, RU, UA, US, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SL).  Published <i>With international search report. In English translation (filed in Swedish).</i></p> <p style="font-size: 2em; text-align: center;">673357</p> 
<p>(54) Title: METHOD FOR OBTAINING HIGH-QUALITY PROTEIN PRODUCTS FROM WHEY</p>		
<p>(57) Abstract</p> <p>High quality protein products are obtained from whey by subjecting whey to cross flow filtration in microfilter. The whey and retentate are brought to circulate in a circulation path on one side of the membrane area of the microfilter, while whey which has passed the membrane area (permeate) is circulating in a second path on the other side of the membrane area in such a way that the pressure drop over the whole membrane area is kept constant and below 0.8 bar. At that there is obtained a fractionation of milk serum protein such that denatured milk serum protein and fat are retained in the retentate and undenatured milk serum protein passes the membrane into the permeate. After an end treatment there is obtained a whey protein product which is rich in α-lactalbumin and β-lactoglobulin and has a low fat content.</p>		

METHOD FOR OBTAINING HIGH-QUALITY PROTEIN PRODUCTS FROM WHEY.

The present invention relates to a method of obtaining high-quality protein products from whey.

5 Whey constitutes the water part which is separated from the curd when producing cheese and casein conventional-ly. The whey amounts to 80-90 % of the total amount of milk and contains about 50 % of the nutrition in the milk i.e. soluble protein, lactose, vitamins and mineral substances. The dry solids content (TS) is ~ 6,3  
10 % where lactose is 4,85 %, protein 0,8 %, fat 0,5 % and salts 0,7 %.

Since cheeses were being produced on a larger scale it has been a problem to dispose of the whey. During a  
15 certain period the whey was discharged into lakes and water courses. Many countries have now forbidden such discharges. In order to make use of the nutrition in the whey to some extent it has been used as animal feed and as fertilizer.

20

For a long time the whey has been considered more as a troublesome by-product which must be taken care of than as a possible resource. During the latest years new  
25 processes for producing high quality whey products have been developed. By evaporation of the whey lactose may be obtained, at which the whey proteins firstly must be separated from the whey in many cases.

When whey is separated from the curd in connection with  
30 cheese production it contains small cheese fines which are separated, e.g. in whey strainers. The cheese fines are used for manufacture of cheese-like products. After the separation of the cheese fines the main part of the fat in the whey may be taken care of in a centrifugal  
35 separator which also separates a further amount of

cheese fines. After separation of fat the whey has a fat content of ~ 0,05 % and may be treated further for example in ultrafilters. The proteins which are present in the whey are sometimes called whey proteins, sometimes milk-serum proteins and when the whey is separated from the curd the proteins are dissolved in the whey. These proteins may be concentrated with different methods depending on among all if they are extracted in unaffected or heat denatured form. During the ultrafiltration substances with low molecular weight pass through the membrane in the ultrafilter and a concentrate is obtained. The permeate which is free from protein is an excellent raw material for production of lactose.

Depending on the degree of concentration (removal of liquid) different kinds of products are obtained. A product with 35 % WPC (Whey Protein Concentrate) contains 35 % protein of the total dry solids content. By a further concentration products with higher protein content may be obtained as 60 % WPC (60 % protein). By way of diafiltration, i.e. addition of demineralized water followed by ultrafiltration, the protein content may be increased to 75-80 % protein. A disadvantage is, however, that not only the protein is concentrated but also the fat, which gives protein products with a fat content of 6-7 %.

Another method of taking care of the whey proteins is heat denaturation of the same, after which they are precipitated with acid. The proteins may then be concentrated, e.g. by means of a centrifugal separator. With this method 90-95 % of the coagulated proteins may be recovered. Protein concentrate of this kind may for

example be used as an additon to milk intended for  
production of cheese.

Conversion of whey to valuable end products demands a  
5 starting material with a low bacterial content. In order  
to obtain such a material the whey has been purified by  
passage of a microfilter where bacteria and spores have  
been separated. If a microfilter with a pore size of  
1,4  $\mu$  is used 99 % of bacteria and spores may be  
10 removed. The amount of retentate, i.e whey which has not  
passed the membrane area in the filter is 3-5 % of the  
amount of supplied whey.

According to the invention it has now surprisingly been  
15 found that if the microfiltration of the whey is carried  
through under certain specified conditions, extremely  
high qualitative products may be obtained from the whey.

The microfiltration is carried through in a way known  
20 per se according to the invention by making supplied  
whey together with retentate to circulate in a  
circulation path on one side of the membrane areas while  
whey which has passed the membrane is brought to  
circulate in a second path. By controlling the pressure  
25 conditions the pressure drop over the whole membrane  
area may be kept constant. If the pressure drop over the  
membrane area is controlled in such a way that it is  
below 0,8 bar, a fractionation of the whey protein is  
obtained in such a way that denatured protein and fat  
30 are detained in the retentate while undenatured protein  
passes the membrane and is obtained in the permeate, at  
which after an end treatment there is obtained a whey  
protein product which is rich in  $\alpha$ -lactalbumin and  $\beta$ -  
lactoglobulin and which has a low fat content.

In order to obtain a satisfactory fractionation the pore size in the membrane is 0,05-1,4  $\mu$ , preferably 0,05-0,7  $\mu$ .

5

The flow rate over the membrane area is with advantage 4-10 m/s, preferably 5-8 m/s.

10 The micro filtration is advantageously carried through in such a way that the pressure drop over the membrane area is below 0,2 bar.

As may be seen in the attached diagram of the relation between the content of true protein in supplied whey (C<sub>f</sub>) and the content of true protein in the permeate (C<sub>p</sub>), and the pressure drop over the membrane (TMP) the portion of true protein in the permeate increases with diminishing pressure drop. Through analyses it has been shown that it is the undenatured proteins that pass the membrane while denatured proteins and fat remain in the retentate. The mechanism which explains this fractionation is obscure, the explanation may possibly be that denatured protein is attracted and adheres to the membrane proteins in the membrane of the fat globules.

25

By working with a low pressure drop over the membrane area, which pressure drop is kept constant over the whole membrane area, i.e. over the available membrane area in the micro filter, the portion of true protein in the permeate may increase which means a higher yield of undenatured protein. The largest yield is obtained with a pressure drop close to zero.

35 According to the method of the invention it is possible to obtain operation periods of at least 20 hours with a

constant capacity and constant passage of proteins by controlling the transmembrane pressure, which is of advantage if the whey for example is preconcentrated by ultrafiltration. The operation time for ultra filtration is usually 20 hours.

Without control of the transmembrane pressure micro filters usually must be cleaned after 8-10 hours.

The protein product with undenatured protein which is obtained according to the method of the invention has, when compared to whey protein products obtained in other ways, better solubility, gelatinizing capacity, viscosity, is a better emulgator and has in particular a better foaming ability, since the product has a low fat content.

Example:

Composition of whey and permeate after microfiltration according to the method of the invention:

	Pure protein		Fat
	Denatured %	Undenatured %	%
Whey	0.12	0.48	0.05
Permeate	< 0.02	0.450	< 0.005

As may be seen in the table there is obtained a protein product with a considerably higher degree (90-95 %) of undenatured protein according to the invention. After drying there is obtained a protein product rich in  $\alpha$ -lactalbumin and  $\beta$ -lactoglobulin but with a low fat content (0.4 %).

Claims

1. Method of obtaining high quality products from whey,  
c h a r a c t e r i z e d i n that whey is subjected  
5 to a cross flow filtration in a microfilter, at which  
supplied whey and retentate are brought to circulate in  
a circulation path on one side of the membrane area of  
the microfilter, while whey which passed the membrane  
surface (permeate) is circulating in a second circu-  
10 lation path on the other side of the membrane area, in  
such a way that the pressure drop over the whole  
membrane area is kept constant and the pressure drop  
over the membrane area is below 0.8 bar at which there  
is obtained a fractionation of milk serum protein in  
15 such a way that denatured milk serum protein and fat is  
retained in the retentate while undenatured milk serum  
protein passes the membrane and is present in the  
permeate, at which after an end treatment of the  
permeate there is obtained a whey protein product rich  
20 in  $\alpha$ -lactalbumin and  $\beta$ -lactoglobulin but with a low fat  
content.
2. Method according to claim 1, c h a r a c t e r i -  
z e d i n that the pore size in the membrane is 0.05 -  
25 1.4  $\mu$ , preferably 0.05-0.7  $\mu$ .
3. Method according to claim 1, c h a r a c t e r i -  
z e d i n that the flow rate over the membrane area is  
4-10 m/s, preferably 5-8 m/s.  
30
4. Method according to claim 1, c h a r a c t e r i -  
z e d i n that the pressure drop over the membrane  
surface is below 0.2 bar.
- 35 5. Method according to claim 1-4, c h a r a c t e -



r i z e d i n t h a t t h e c r o s s f l o w f i l t r a t i o n i n t h e  
m i c r o f i l t e r i s c a r r i e d t h r o u g h w i t h a o p e r a t i o n t i m e o f  
a t l e a s t 2 0 h o u r s w i t h a c o n s t a n t c a p a c i t y a n d c o n s t a n t  
p a s s a g e o f p r o t e i n b y c o n t r o l o f t h e t r a n s m e m b r a n e  
p r e s s u r e .

DATED this 9th day of September, 1996

TETRA LAVAL HOLDING & FINANCE S.A.

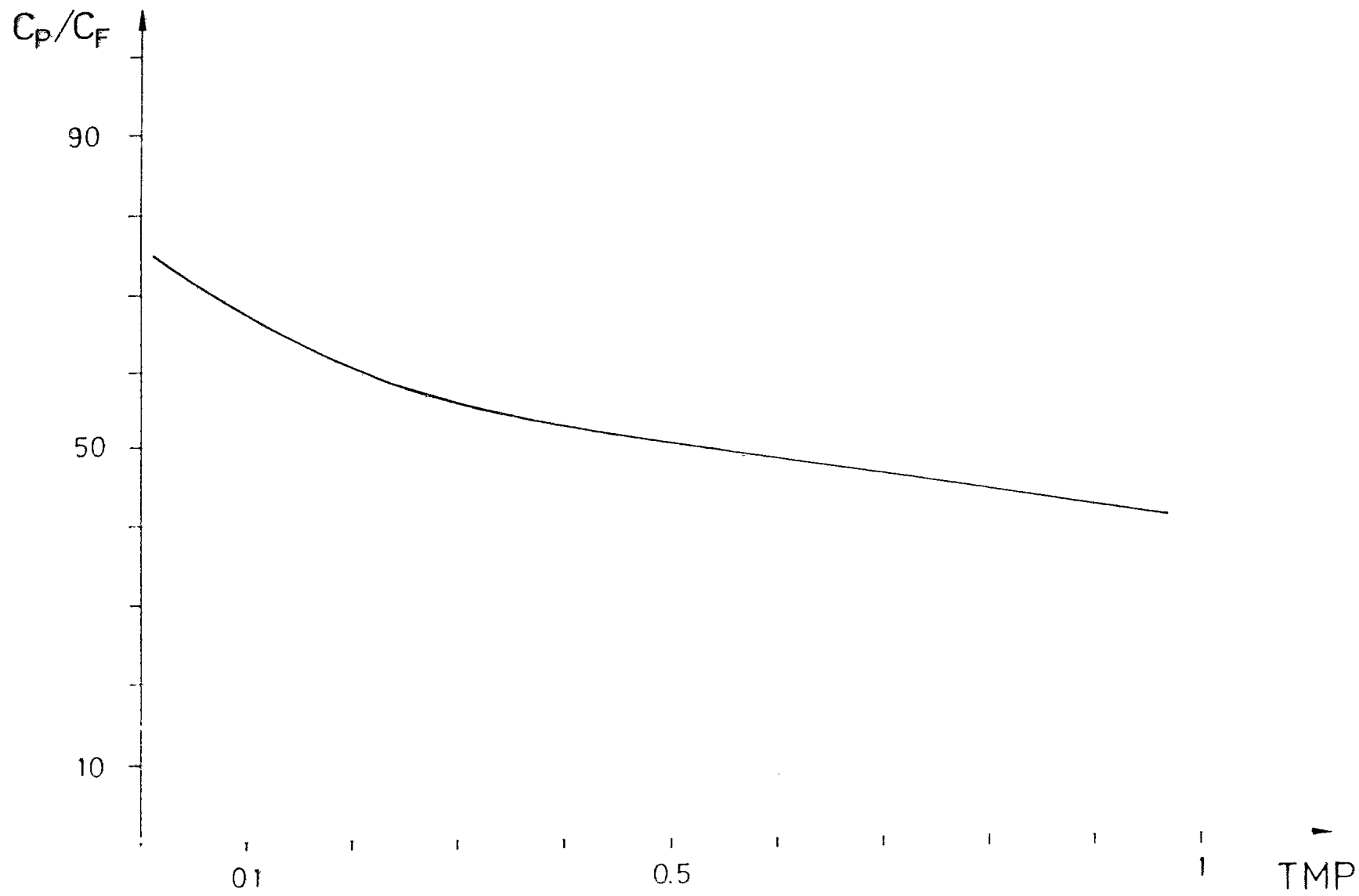
WATERMARK PATENT & TRADEMARK ATTORNEYS  
290 BURWOOD ROAD  
HAWTHORN VICTORIA 3122  
AUSTRALIA

1  
5  
5  
5  
5

8  
8  
8

9  
9  
9

A handwritten signature in dark ink is written over a circular stamp. The stamp contains some illegible text, possibly a date or reference number.



1/1

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE 93/00378

## A. CLASSIFICATION OF SUBJECT MATTER

IPC5: A23J 1/20

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols):

IPC5: A23J

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EDOC, WPI, CA

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP, A1, 0374390 (BOUNOUS, G. ET AL.), 27 June 1990 (27.06.90), claims 1,5,13 --	1
A	EP, A2, 0311283 (EXPRESS FOODS GROUP LIMITED), 12 April 1989 (12.04.89), figures 1,2, claims 1,2 --	1
A	EP, A2, 0320152 (EXPRESS FOODS GROUP LIMITED), 14 June 1989 (14.06.89), figure 4, claim 1 --	1

 Further documents are listed in the continuation of Box C. See patent family annex.

\* Special categories of cited documents.

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&amp;" document member of the same patent family

Date of the actual completion of the international search

9 August 1993

Date of mailing of the international search report

11 -12- 1993

Name and mailing address of the ISA  
 Swedish Patent Office  
 Box 5055, S-102 42 STOCKHOLM  
 Facsimile No. +46 8 666 02 86

Authorized officer

INGA-KARIN PETERSSON  
 Telephone No. -46 8 782 25 00

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE 93/00378

## C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No
A	Chemical Abstracts, Volume 97, No 21, 22 November 1982 (22.11.82), (Columbus, Ohio, USA), Amundson, C.H. et al., "Production of enriched protein fractions of $\beta$ -lactoglobulin and $\alpha$ -lactalbumin from cheese whey", page 654, THE ABSTRACT No 180496a, J. Food Process. Preserv. 1982, 6 (2), 55-71, (Eng.) --	1
A	WO, A1, 8911226 (INSTITUT NATIONAL DE LA RECHERCHE AGRONOMIQUE), 30 November 1989 (30.11.89), claim 1 --	1
A	EP, A1, 0022696 (INSTITUT NATIONAL DE LA RECHERCHE AGRONOMIQUE), 21 January 1981 (21.01.81), claims 1,10 -----	1

**INTERNATIONAL SEARCH REPORT**  
Information on patent family members

International application No

02/07/93

PCT/SE 93/00378

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP-A1- 0374390	27/06/90	AU-A- 4670189	28/06/90
		CA-A- 2005779	23/06/90
		CN-A- 1044659	15/08/90
		EP-A- 0339656	02/11/89
EP-A2- 0311283	12/04/89	SE-T3- 0311283	
		AU-A- 2290988	13/04/89
		DE-A- 3869037	16/04/92
		JP-A- 1165343	29/06/89
		US-A- 5008376	16/04/91
EP-A2- 0320152	14/06/89	AU-A- 2671488	15/06/89
		DE-A- 3877338	18/02/93
		JP-A- 1230600	14/09/89
		US-A- 5194591	16/03/93
WO-A1- 8911226	30/11/89	AU-A- 3749389	12/12/89
		FR-A- 2631785	01/12/89
EP-A1- 0022696	21/01/81	SE-T3- 0022696	
		AU-B- 538288	09/08/84
		AU-A- 5966680	08/01/81
		CA-A- 1136919	07/12/82
		FR-A,B- 2459619	16/01/81
		JP-C- 1701735	14/10/92
		JP-B- 3062720	26/09/91
		JP-A- 56036494	09/04/81
		US-A- 4485040	27/11/84
		US-A- 4711953	08/12/87