**Title:** PROCESS FOR ENHANCEMENT OF YIELD OF COTTAGE CHEESE (PANEER) BY RE-CIRCULATION OF CONCENTRATED WHEY

**Schematic of Paneer Making**

**Modified State of Art**

Collection of milk → Heat treatment for pasteurization & denature whey proteins → Mixing tank at pH 6.5 & above is the inedible state of milk → Holding for 5-10 min. → Hot whey Collection → Drainage of whey by retaining the Paneer in Hoop lined Muslin cloth (Housing) → Pressure on Paneer Block to attain the required Moisture (Preserving) → Hot whey Collection → Cutting & packing as per sale practice → Concentrate Whey to 25% → Heat exchanger → Cool whey to 45°C or lower → Filtration by UF / RO membranes → Filtration by Nano / RO membranes → To ETP / reuse for floor washing → Salts & water ~ 75% of whey Volume

**Abstract:** A process for enhancing the recovery of paneer from milk comprising: i) collection of milk, ii) heat treatment for pasteurization and denaturing whey proteins, iii) collecting product obtained from (ii) above in a mixing tank for desired duration till the desired pH is achieved, iv) draining whey by retaining the paneer by hooping, v) collecting hot whey drained from step (iv) above in a non-reactive tank, vi) passing the hot whey so collected through heat exchanger to reduce its temperature to an optimum level, vii) filtering the cooled whey suitably for removing suspended particle and to substantially concentrate solid not fat (SNF), viii) recirculating the concentrated whey by feeding in step (iii) above as coagulator for paneer making/processing, ix) repeating steps (iii) to (viii) as above as many times as needed to obtain desired substantially enhanced yield of recovered paneer and until the residual liquid contains no proteins and the same liquid be used for other industrial purposes.
DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT,
LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE,
SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA,
GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:

— with international search report (Art. 21(3))
FIELD OF THE INVENTION

The present invention relates in general to processes for the recovery of whey protein as paneer from whey and more particularly to a process for enhancement in the yield of cottage cheese (paneer) by re-circulation of concentrated whey. It is a closed loop process in which whey, which is produced by coagulation of milk, is again concentrated and re-processed to produce cottage cheese (paneer). This process also substantially mitigates environmental pollution, by recycling whey which is otherwise dumped in the drains or water bodies.

BACKGROUND AND PRIOR ART

In India, cottage cheese is popularly known by names like paneer and chhena. Both these names and may be other in different region / language have been used in this specification to mean cottage cheese. Out of the two, paneer is more widely known and herein after referred to as paneer only.

Paneer is a heat- and acid-coagulated traditional milk product, mainly consisting of milk solids obtained from the coagulation of hot milk with organic and / or inorganic acids and subsequent drainage of the whey, followed by pressing. Paneer is characterized by its typical mild acidic flavour with a slightly sweet taste. It has firm, cohesive and spongy body and has a smooth texture. It is mostly used as a delicatessen in preparation of different dishes as well as in making sweets, salad, snacks, etc. Paneer is used as a raw material for preparing various popular dishes such as Paneer bajji, Paneer pakoda, Paneer masala, Paneer butter masala, Paneer cutlet, baked Paneer and Paneer coconut balls.
The production of paneer has largely been confined to the unorganized dairy sector which employs traditional, inefficient methods of manufacture. Mostly, the production units discharge the untreated whey into the drains, since only few such units have effluent treatment plants. Thus this industry as a whole has a large and adverse impact on the environment. The untreated whey being discharged in the drains comes in contact with the waste waters in the system contaminates the entire drainage system and helps in bacterial and fungal growths.

Present state of art of Paneer manufacturing process:

Following steps are used at present for paneer (cottage cheese) manufacturing:

- **Heat treatment of milk**

Heat treatment of milk has a profound effect on physico-chemical, sensory and microbiological properties of paneer. It also affects TS recovery and thus the yield of paneer. Heat treatment of milk is essential to destroy the pathogenic as well as spoilage micro-organisms. It also denatures whey proteins, reduces solubility of colloidal calcium phosphate, thus co-precipitating them along with the casein upon acidification of milk. These constituents increase the yield of curds, which are otherwise lost in the whey. Heat treatment at 90°C for 10-15 min was necessary to achieve desired yield. Different time-temperature combinations are adopted by various manufacturers.

**Type and strength of coagulant:**

Paneer manufacture involves the coagulation of milk proteins to form curd. During this process large clumps of proteins are formed in which fat and other colloidal and dissolved solids get entrapped. The coagulation of milk occurs when pH of milk reaches 4.6 which is the isoelectric point of its major protein, casein. The type and
concentration of the acid and the mode of delivery into the hot milk influence the moisture level and product yield.

Several coagulants have been tried, namely, lemon juice, citric acid, tartaric acid, lactic acid, malic acid, hydrochloric acid, phosphoric acid, acetic acid, fermented milk, sour/cultured whey, yoghurt and lactic cultures. Calcium lactate has also been used as coagulant. The concentration of the coagulant has a profound effect on the body and texture of paneer. While a low acid strength results in a soft body and smooth texture, high acid strength results in a hard body.

**Strength of coagulants used for paneer making:**

The amount of coagulant required for coagulation of milk depends upon the type of milk, buffering capacity of milk, type of coagulant and the coagulation temperature employed.

**Temperature of coagulation**

The temperature and pH of coagulation have a significant effect on the body and texture, the total solids (TS) recovery and the yield of paneer. The optimum temperature of coagulation differs for different types of milk and their composition, including fat. Coagulation temperature influences moisture retention in paneer. An increase in temperature of coagulation from 60 to 90 °C decreased the moisture content of paneer from 59.0 to 49.0%. Paneer obtained by coagulating milk at 70 °C had the best organoleptic quality and has the desired frying quality namely integrity/shape retention and softness.

A coagulation temperature of 70 °C has been recommended for paneer making from buffalo milk. Temperatures higher than this resulted in dry and hard paneer while lower temperature yielded product having a very moist surface. It has been
recommended by some researchers to use higher (85 °C) and lower (72°C) coagulation temperature for buffalo milk paneer. Some have recommended coagulation temperature of 85°C for low-fat buffalo milk.

To obtain good quality paneer, most research workers recommended higher coagulation temperature for cow milk. The suggested coagulation temperature for obtaining good quality paneer from cow milk was 80-85°C. Coagulation temperature of 90° and 70 °C has been recommended when preparing paneer from ewe's milk and mixed milk respectively. 90°C of coagulation temperature has also been suggested by some scientists for making paneer from recombined cow milk. Low coagulation temperature of 60°C is also known to be used.

**pH of coagulation**

Variation in the pH of coagulation has a significant effect on the body and texture, flavour, quality and yield of paneer. It has been reported that with the fall in pH (5.5-5.0), the moisture retention and yield of paneer decreased. Paneer made from cows' milk coagulated at pH 5.0 was sensorily superior to the one coagulated at pH 5.5. However, at coagulation pH of 5.0 the moisture, TS recovery and yield were lower. The moisture content and yield of paneer increased from 50 to 58.6% and from 20.8 to 24.8% respectively, when coagulation pH increased from 5.1 to 5.4. Sensory quality was best at pH 5.3-5.35 which is recommended for paneer making from buffalo milk. The pH range of 5.20-5.25 for cow milk paneer is also recommended by some scientists.

**Whey drainage**

After coagulation of milk, the curd is allowed to settle down for 5 min without stirring. During this period the temperature should not be allowed to drop below 63 °C. Thereafter, the curd along with the whey is transferred into a hoop lined with muslin cloth to remove the whey. This is already reported.
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**Hooping and pressing**

After the curd is transferred to hoops lined with muslin cloth, it is subjected to pressing to obtain a compact block of paneer. Different research workers have used different amounts of pressure for varied time periods for paneer manufacture.

Some applied pressure of 40-45 kg for 10-15 min for paneer hoop sized 35x28x10 cm for buffalo milk paneer with moisture around 56%. Others employed a pressure of 2 kg/cm² for 25 min on wooden hoop (4x4x4 inches) to obtain paneer with 55.0% moisture, while it is also suggested applying a pressure of 1 kg/cm² and found moisture level in paneer was inversely related to the pressure applied. Use of 0.08 kg/cm² for paneer preparation from cow and buffalo milk is also reported and this resulted in paneer with 47.9 and 42.7% moisture respectively. Some scientists have recommended higher weights of 70-100 kg on hoops for 10-15 min.

Some prevailing knowledge in the existing state of the art of paneer making is highlighted below:

The application of mechanization to modernize *Paneer* technology is known. In order to achieve economy in cost of production, higher yield and uniformity in product quality, adoption of membrane processing has been reported.

Some researchers have suggested that the yield of *Paneer* made by ultra filtration technique, increased by about 25 % due to the higher retention of whey proteins and moisture. Researcher from Department of Agriculture and Food Engineering, IIT, Kharagpur, India developed a process for centrifugal method of *Paneer* production. The process involved centrifugal pressing of chhana in a double wall basket centrifuge (30 - 60°C) and chilling of pressed chhana inside the centrifuge by chilled water at 4°C in the ratio of 1:5. Pressing and chilling of chhana in basket centrifuge considerably reduced the time (24 minutes) for *Paneer* production.

In general the prior art technologies on Paneer production do not emphasize on advocating a single technology for achieving two vital needs of the hour in Paneer
OBJECTS OF THE INVENTION

The primary object of the present invention is to enhance the yield of cottage cheese (paneer) by re-circulation of concentrated whey.

Another object of this invention is to recover the whey protein as paneer from waste whey.

Yet another object of the present invention is to reduce environment pollution by stopping the discharge of untreated whey into water bodies.

Still another object of the present invention is to meet the ever growing demand for paneer in the market without increasing the quantity of milk.

Yet another object of the invention is to increase the yield of the paneer from recycled whey without compromising with the quality of the paneer so produced from the re-cycled whey.

How the foregoing objects are achieved will be clear from the following description. In this context it is clarified that the description provided is non-limiting and is only by way of explanation.

SUMMARY OF THE INVENTION

Accordingly the present invention provides a process for enhancing the recovery of paneer from milk comprising:

i) collection of milk,
ii) heat treatment for pasteurization and denaturing whey proteins,
iii) collecting product obtained from (ii) above in a mixing tank for desired duration
till the desired pH is achieved,
iv) draining whey by retaining the paneer by hooping,
v) collecting hot whey drained from step (iv) above in a non-reactive tank,
vi) passing the hot whey so collected through heat exchanger to reduce its
temperature to an optimum level,
vii) filtering the cooled whey suitably for removing suspended particle and to
substantially concentrate solid not fat (SNF),
viii) recirculating the concentrated whey by feeding in step (iii) above as coagulator
for paneer making/processing,
ix) repeating steps (iii) to (viii) as above as many times as needed to obtain desired
substantially enhanced yield of recovered paneer and until the residual liquid
contains no proteins and the same liquid be used for other industrial purposes.

Preferably, the desired number of times in step ix) is ten.

BRIEF DESCRIPTION OF THE ACCOMPANYING DRAWINGS

The nature and scope of the present invention will be better understood from the
accompanying drawings, which are by way of illustration of a preferred embodiment
and some non-restrictive examples not by way of any sort of limitation. In the
accompanying drawings:-

Figure 1 is a flow diagram showing the conventional method of making paneer.

Figure 2 is a flow diagram showing the method of making paneer according to the
present invention.

Fig 3 is a graph showing the relative recovery of paneer from waste whey.
DETAILED DESCRIPTION OF THE INVENTION

Having described the main features of the invention above, a more detailed and non-limiting description with reference to some non-restrictive examples is provided in the following paragraphs. The description would be clear on referring to non-limiting accompanying drawings.

In all the figures, like reference numerals represent like features. Further, the shape, size and number of the devices shown are by way of example only and it is within the scope of the present invention to change their shape, size and number without departing from the basic principle of the invention.

All through the specification including the claims, the technical terms and abbreviations are to be interpreted in the broadest sense of the respective terms, and include all similar items in the field known by other terms, as may be clear to persons skilled in art. Restriction or limitation if any referred to in the specification, is solely by way of example and understanding the present invention.

Figure 1 is a self explanatory flow diagram of a conventional method of manufacturing paneer. Figure 2 is a flow diagram of a preferred embodiment of the method according to the present invention. Figure 2 is also self explanatory, and comparing the two diagrams, the basic difference would be very clear. Such differences would be also very clear from the following description. Further the cooling step shown in figure 2 is within 45°C and this is within the scope of the present invention.

In the conventional method whey is discharged as waste material during the process of Hooping and Pressing. This waste whey cause contamination of the water bodies, which results into environmental pollution.

The main crux of the subject invention is lies here. It play two vital roles in paneer production i.e. the claimed process used the waste whey for enhancing the paneer
production and at the same time eliminates the risk of environmental pollution which caused by untreated discharge of whey into environment.

The highlights of the new process are listed below:

Collection of hot whey from paneer production line in non-reactive tanks

It is passed through heat exchanger to reduce the temperature to 45°C or lower. Cooled whey is first filtered through microfilter and ultra filtration for removing any suspended particle.

This filtered whey is passed through nano or RO filtration unit.

After filtration, the volume of whey is reduced to near about 25% that of the original volume or concentration of Solid Not Fat (hereinafter referred to as SNF) up to minimum 12% at this stage. The concentration of SNF largely depends on the quality and type of the milk.

This concentrated whey proteins are retained for recirculation as coagulator for further paneer making/processing. This recirculation may take place n number of times depending upon requirement of degree of enhancement. For example, it may take place ten times.

Modification in process

Discharged Hot whey is collected in non-reactive metal tanks. It is passed through Heat exchanger to reduce the temperature to 45°C or lower. Cooled whey is first filtered through Micron filter & Ultra filtration for removing any suspended particle. This filtered whey is passed thru Nano or reverse osmosis (RO) Filtration unit. This stage of unit is designed in such a way that it reduces the volume of whey to near about 25% than that of the original volume (or Concentration of SNF up to
minimum 12.0% at this stage). The concentration of the SNF largely depends on
the quality and type of milk used at the beginning of the process. This concentrated
whey protein and SNF solutions are retained for re-circulation as coagulators for
further paneer making or processing. Permeate water, thus collected can be utilized
for floor washing or making brine water for packing the finished tinned product.

Design considerations for process by way of non-restrictive example.

The temperature of whey is a critical design parameter in new state of art.
Collected whey should be brought down to 45°C or less within as soon as possible
of production. For energy conservation & efficiency, heat exchangers made of non
reactive metal are to be used. This step also reduces the chance of microbial
contamination also.

Heat exchanger circuit also has Cleaning in process (CIP) arrangement consisting of
One set of Pumps (1 working + 1 Standby), CIP tank/s fitted with mixture
arrangement. The Material of construction (MOC) for all above including piping &
fittings should be made of non reactive material.

The Solid Not Fat content of whey is important design parameter for recovery of
Paneer. The efficiency of invented process depends upon concentration of SNF of
whey the best results are obtained at SNF value of more than 12.0%.

Pretreatment of Whey

The cooled whey has particles of coagulated Milk/ curd; these particles could create
the fouling in membranes used for concentration. Therefore Two stage membrane
based pre-filtration process is designed. Whey is passed through micron filtration of
bag type followed by standard micron cartridge filter of 10 & 1 micron. Followed by
Ultra filtration membrane in cross flow mode with Molecular weight cutoff (MWCO)
of 1,00,000 Da. or less. The operating pressure of system is as per membrane
manufacturer's’ specifications. The system should have safety arrangement i.e it
shut down itself if pressure is increased to desired / pre-defined pressure.
Concentration of Whey

This cleared & filtered whey is fed to array of Nano & Low energy reverse osmosis / regular Reverse Osmosis membrane Elements by set of high pressure pumps (1 working + 1 standby).

The array has following design requirements by way of example.

- Flow rates minimum cross flow velocity of 0.8 m/s.
- Maximum pressure of 17.5 Kg/Sq. Cm.
- The array is equipped for shutdown in case of feed temperature is more than 45° C
- Pumps should be shut down in case Trans membrane pressure is more than 1.5 bar
- All selected membrane has to be sanitised by hot water at 75° C.
- Membrane configuration is selected in such a way that volume of Whey is reduced up to near about 1/4 \textsuperscript{th} of original volume or SNF is reached up to around 12.0 \% whichever comes first.
- The membrane system should have CIP Circuit and hot water sanitation arrangement.
- Concentrated whey is stored at less than 15° C temperature.

Use of concentrated Whey as coagulant for making paneer.

The concentrated whey is used in place of coagulant for paneer making.

This is achieved by heating milk, (SNF value up to 8.4), to 70° C and adding concentrated whey till isoelectric point is achieved (for best results in terms of body texture, softness of paneer buffalo milk with pH range of 5.3-5.1 is recommended).
Quantity used of whey as coagulant is dependent upon the type of milk, buffering capacity of milk, pH of Concentrated whey, lactation period and the coagulation temperature employed.

It would be clear from the description hereinabove, that the new innovative process addresses the issue of environment pollution by stopping the discharge of whey protein into nature and simultaneously enhances the yield of cottage cheese (paneer) by re-circulation of concentrated whey.

In this process inorganic salts and water are removed from the whey by use of any or combination of following membranes viz. Micro Filtration (MF), Ultra Filtration (UF), Nano Filtration (NF) & Reverse Osmosis (RO). The selection of membrane is dependent of origin of milk. The volume of whey is reduced to 28%. This concentrated whey proteins & SNF solution are retained for re-circulation as coagulator of further paneer making/ processing.

This modified process minimizing impact on pollution by Dairy Industry. During recirculation of concentrate whey, whey protein also gets coagulated during the processing of Paneer, thus increasing recovery up to 25 % depending upon the milk composition & lactation period.

**COMPARATIVE STUDY TO EVALUATE THE POTENCY OF THE NEW METHOD OVER THE CONVENTIONAL METHOD**

**EXAMPLE I**

100 lt. of cow milk is started with. In the conventional method the yield of paneer is approximately 14.1 kg from 100 lt. of cow milk. The yield of paneer can now increased about 19% by using the waste whey collected from 100 lt. of cow milk. In the first step the hot whey is collected in non-reactive tanks. The waste whey contains 7.25% of SNF in its initial stage. It is then passed through heat exchanger
to reduce the temperature to 45°C or lower. The cooled whey is now filtered through microfilter and ultra filtration for removing any suspended particle. This filtered whey is passed through nano or RO filtration unit. After filtration, the volume of whey is reduced to near about 28% of the original volume or concentration of SNF upto minimum 12.9% at this stage for cow milk. This concentrated whey proteins are retained for recirculation as coagulator for further paneer making/processing. It is observed that the total yield of paneer by using the new method is approximately 17.4 kg from 100 lt. of cow milk. Thus, in an average it is possible to recover 18.97% or more of paneer from waste whey.

**EXAMPLE II**

The above experiment is now performed with 100 lt. of buffalo milk. In the conventional method the yield of paneer is approximately 16.2 kg from 100 lt. of buffalo milk. The yield of paneer can now increased about 18% by using the waste whey collected from 100 lt. of buffalo milk. In the first step the hot whey is collected in non-reactive tanks. The waste whey contains 7.83% of SNF in its initial stage. It is then passed through heat exchanger to reduce the temperature to 45°C or lower. The cooled whey is now filtered through microfilter and ultra filtration for removing any suspended particle. This filtered whey is passed through nano or RO filtration unit. After filtration, the volume of whey is reduced to near about 25% of the original volume or concentration of SNF upto minimum 13.4% at this stage for buffalo milk. This concentrated whey proteins are retained for recirculation as coagulator for further paneer making/processing. It is observed that the total yield of paneer by using the new method is approximately 19.8 kg from 100 lt. of buffalo milk. Thus, in an average it is possible to recover 18.18% of paneer from waste whey.
The above experiment is now performed with 100 lt. of mixed cow and buffalo milk in a ratio of 4:6. In the conventional method the yield of paneer is approximately 15.8 kg from 100 lt. of mixed milk. The yield of paneer can now increased about 19.43% by using the waste whey collected from 100 lt. of mixed milk. In the first step the hot whey is collected in non-reactive tanks. The waste whey contains 7.4% of SNF in initial stage. It is then passed through heat exchanger to reduce the temperature to 45°C or lower. The cooled whey is now filtered through microfilter and ultra filtration for removing any suspended particle. This filtered whey is passed through nano or RO filtration unit. After filtration, the volume of whey is reduced to near about 32% of the original volume or concentration of SNF upto minimum 12.4% at this stage for mixed milk. This concentrated whey proteins are retained for recirculation as coagulator for further paneer making/processing. It is observed that the total yield of paneer by using the new method is approximately 19.43 kg from 100 lt. of mixed milk. Thus, in an average it is possible to recover 18.68% of paneer from waste whey.

The recovery of paneer from waste whey from different kind of milk is represented graphically in the accompanying figure 3. The results discussed in Examples I, II and III are clearly illustrated in the accompanying figure 3.

The present invention has been described with reference to some drawings and examples purely for the sake of understanding and not by way of any limitation and the present invention includes all legitimate developments within the scope of what has been described herein before and claimed in the appended claims.
I CLAIM:

1. A process for enhancing the recovery of paneer from milk comprising:
   i) collection of milk,
   ii) heat treatment for pasteurization and denaturing whey proteins,
   iii) collecting product obtained from (ii) above in a mixing tank for desired duration till the desired pH is achieved,
   iv) draining whey by retaining the paneer by hooping,
   v) collecting hot whey drained from step (iv) above in a non-reactive tank,
   vi) passing the hot whey so collected through heat exchanger to reduce its temperature to an optimum level,
   vii) filtering the cooled whey suitably for removing suspended particle and to substantially concentrate solid not fat (SNF),
   viii) recirculating the concentrated whey by feeding in step (iii) above as coagulator for paneer making/processing,
   ix) repeating steps (iii) to (viii) as above as many times as needed to obtain desired substantially enhanced yield of recovered paneer and until the residual liquid contains no proteins and the same liquid be used for other industrial purposes.

2. The process as claimed in claim 1 wherein the milk is 100 litres of cow milk and the yield of paneer obtained is 17.4 kg.

3. The process as claimed in claim 1 wherein the milk is 100 litres of buffalo milk and the yield of paneer obtained is 19.8 kg.

4. The process as claimed in claim 1 wherein the milk is 100 litres of mixed cow milk and buffalo milk and the yield of paneer obtained is 19.43 kg.

5. The process as claimed in claim 1 wherein the temperature in step vi) is 45°C or lower.
6. The process as claimed in claim wherein in step vii) the whey is filtered through microfilter and ultra filtration for removing any suspended particle and then passed through nano or RO filtration unit.

7. The process as claimed in claim 1 wherein after finishing step ix) the Paneer is retained in step iv) by hooping in muslin cloth and pressurized to attain the required moisture, followed by cutting and packing as per sale practice.

8. The process as claimed in claim 1 wherein in step ii) the desired pH is 4.6 which is the isoelectric point.

9. The process as claimed in claims 1 and 7 wherein the desired number of times in step (ix) is ten.

10. A process, substantially as herein described, particularly with reference to the examples and the accompanying drawings.
SCHEMATICS OF PANEER MAKING

PRESENT STATE OF ART

1. Collection of milk → Heat treatment for pasteurization & denatures whey proteins

2. Addition of coagulant → Mixing tank till pH 4.6 which is the isoelectric point

3. Holding for 5~10 min.

4. Whey to drain or ETP → Drainage of whey by retaining the Paneer in Hoop lined Muslin cloth (Hooping)

5. Whey to drain or ETP → Pressure on Paneer Block to attain the required Moisture (Pressing)

6. Cutting & packing as per sale practice

FIG. 1
SCHEMATICS OF PANEER MAKING

MODIFIED STATE OF ART

Collection of milk → Heat treatment for pasteurization & denaturates whey proteins → Mixing tank till pH 4.6 which is the isoelectric point → Holding for 5~10 min. → Addition of Concentrate whey as coagulant

Collection of whey → Drainage of whey by retaining the Paneer in Hoop lined Muslin cloth (Hooping) → Pressure on Paneer Block to attain the required Moisture (Pressing) → Cutting & packing as per sale practice

Hot whey Collection → Heat exchanger → Cooled whey to 45°C or lower → Filtration by UF membrane → To ETP/ reuse for floor washing

Cooled water/ Chilled water → Filtration by Nano / RO membrane → Concentrate Whey to 25%

Salts & water ~ 75 % of whey Volume

FIG. 2
Recovery of Paneer

ORIGIN OF MILK

- □ Start SNF in % Whey
- □ SNF in Concentrated Whey
- □ Increment in recovery in %

FIG. 3
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER

INV. A23C19/045 A23C19/09 A23C19/076 A23C19/05

ADD.

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

INV.

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

A23C A01J

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

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

EPO-Internal, WPI Data, FSTA

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category

Citation of document, with indication, where appropriate, of the relevant passages

Relevant to claim No.


paragrapges [0026], [0031], [0034], [0045]; cl aims 1-3

1-9

Date of the actual completion of the international search

20 February 2017

Date of mailing of the international search report

28/02/2017

Name and mailing address of the ISA

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Authorized officer

Groh, Bjbrn

Form PCT/ISA/210 (second sheet) (April 2005)
INTERNATIONAL SEARCH REPORT

Box No. II  Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1.   Claims Nos.: because they relate to subject matter not required to be searched by this Authority, namely:

2.  ☒ Claims Nos.: 10
   because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
   see FURTHER INFORMATION sheet PCT/ISA/210

3.  ☐ Claims Nos.: because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III  Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1.  ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2.  ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.

3.  ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4.  ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees.
FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

Claim 10 is defined by a vague reference to "as herein described", particularly with reference to the examples and the drawings. The extent of claim 10 is so vague (Art. 6 PCT) that a reasonable search can not be conducted.

The applicant’s attention is drawn to the fact that claims relating to inventions in respect of which no international search report has been established need not be the subject of an international preliminary examination (Rule 66.1(e) PCT). The applicant is advised that the EP0 policy when acting as an International Preliminary Examining Authority is normally not to carry out a preliminary examination on matter which has not been searched. This is the case irrespective of whether or not the claims are amended following receipt of the search report or during any Chapter II procedure. If the applicant proceeds into the regional phase before the EP0, the applicant is reminded that a search may be carried out during examination on before the EP0 (see EP0 Guidelines C-IV, 7.2), should the problems which led to the Article 17(2) declaration be overcome.
<table>
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<tr>
<th>Patent document cited in search report</th>
<th>Publication date</th>
<th>Patent family member(s)</th>
<th>Publication date</th>
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<td>US 2012219665 A1</td>
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