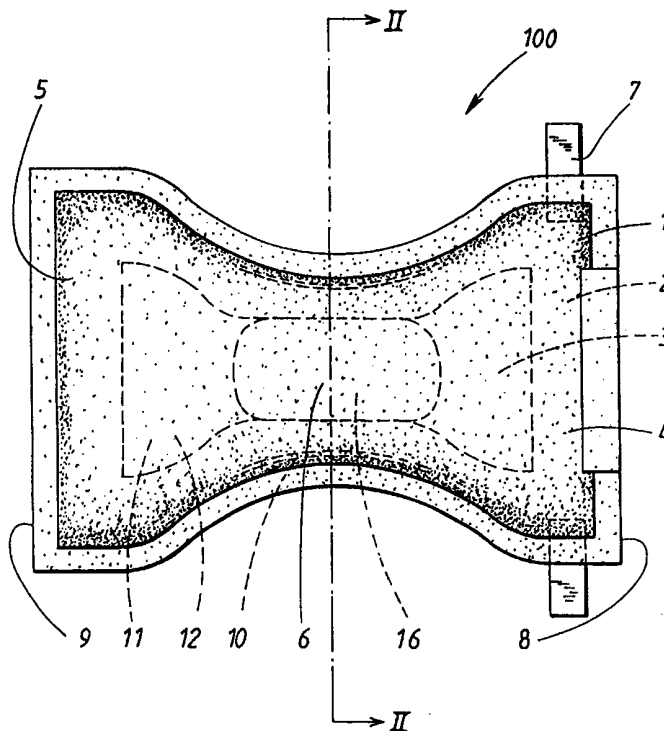


## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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<b>(21) International Application Number:</b> PCT/SE99/02369 <b>(22) International Filing Date:</b> 15 December 1999 (15.12.99)  <b>(30) Priority Data:</b> 9804390-4      16 December 1998 (16.12.98)      SE  <b>(71) Applicant (for all designated States except US):</b> SCA HYGIENE PRODUCTS AB [SE/SE]; S-405 03 Göteborg (SE).  <b>(72) Inventors; and</b> <b>(75) Inventors/Applicants (for US only):</b> FORSGREN-BRUSK, Ulla [SE/SE]; Plommonvägen 35, S-435 43 Pixbo (SE). RUNEMAN, Bo [SE/SE]; Jons väg 6, S-433 75 Jonsered (SE).  <b>(74) Agents:</b> BERG, S., A. et al.; Albihns Patentbyrå Stockholm AB, P.O. Box 5581, S-114 85 Stockholm (SE).		<b>(81) Designated States:</b> AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).  <b>Published</b> <i>With international search report.</i> <i>Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i>

**(54) Title:** ABSORBENT ARTICLES**(57) Abstract**

The invention relates to an absorbent article that includes a synergistic combination of a) a pH-regulating substance in the form of a partially neutralised superabsorbent material, and b) lactic acid bacteria wherein after being wetted and worn close to the skin, the article has a pH value in the range of 3.5-5.5, preferably within the range of 3.5-4.9, and most preferably within the range of 4.1-4.7.



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## ABSORBENT ARTICLES

### FIELD OF INVENTION

5 The present invention relates to absorbent articles of the kind that are worn in contact with the wearer's skin, such as diapers, incontinence protectors, sanitary napkins and like articles. The invention also relates to methods of reducing the undesired side effects that may sometimes occur when using such articles.

### 10 KNOWN TECHNIQUES

Absorbent articles of this kind are known in many different forms. The absorbent body of such products is conventionally produced by dry-defibring cellulose pulp, e.g. cellulose pulp in roll, bale or sheet form, and converting the dry-defibred pulp in a fluffed state to a  
15 pulp mat, sometimes with an admixture of so-called superabsorbents. Superabsorbents are polymers that are able to absorb several times their own weight of water or body fluid.

A typical problem relating to absorbent articles such as diapers, sanitary napkins,  
20 incontinence protectors or the like is that their use can lead to undesired side effects, such as skin irritation and malodours. These problems can occur as a result of occlusion, the presence of moisture, and factors of a mechanical, microbial and enzymatic nature, all of which coact with and amplify the effect of one another to different extents. For instance, several undesired side effects can occur as a result of or in conjunction with an increase  
25 in pH.

U.S. 3,794,034 describes the significance of pH in an absorbent article and also teaches impregnation of the article with buffering substances by means of which the pH in the article can be kept between 3.5-6.0, which is beneficial both with respect to the inhibition of the growth of undesired bacteria and therewith the occurrence of undesirable odours,  
30 and also in avoiding negative skin affects.

EP 0.311,344 describes controlling pH in absorbent articles, wherein the buffering properties are obtained with the aid of a partially neutralised superabsorbent material and an antimicrobial substance chosen from among ordinary nitrogen-based compounds or bis-guanide compounds. The undesirable side effects can be reduced, by controlling the pH of the article so that it will not exceed a given level. However, not all harmful microorganisms are influenced negatively by a low pH value. *Escherichia coli*, which is itself acid-producing, is an example of such a microorganism. The antimicrobial substances can also give rise to problems. For instance, these substances can give rise to allergies or skin irritation with long-time use. Moreover, general discussions are ongoing as to whether or not comprehensive use of antibiotics can result in an increasing resistance of harmful bacteria strains to antibiotics. Finally, the use of antibiotics can have negative ecological consequences with regard to the handling of waste.

Attempts to solve the aforesaid problems of undesirable odours and the growth of undesirable microorganisms have also been made by actively adding specific microorganisms to absorbent articles of the aforesaid kind. For example, one such technique is described in WO 97/02846. These specific microorganisms are primarily lactic acid producing bacteria, such as different species of the strains *Lactobacillus* and *Lactococcus*, which have an antagonistic effect on other microorganisms.

However, the aforesaid known techniques have not completely eliminated the problems of undesirable odours and the growth of undesirable microorganisms. Consequently, there is a need for improvements that can further reduce the problems associated with malodours and the growth of microorganisms.

## SUMMARY OF THE INVENTION

It has now surprisingly been found that the aforesaid problems associated with undesirable side effects, such as malodours and skin irritation, can be reduced still further by using an absorbent article that contains a synergistic combination of

a) a pH-regulating substance in the form of a partially neutralised superabsorbent material, and

b) lactic acid bacteria,

where the pH value of said article subsequent to being wetted when worn against the skin lies in the range of 3.5-5.5, preferably within the range of 3.5-4.9, and most preferably within the range of 4.1-4.7.

## DEFINITIONS

The term "absorbent article" as used in this document relates to absorbent articles that are worn against the skin, such as diapers, incontinence protectors and sanitary napkins.

The term "superabsorbent" and the acronym "SAP" relates to polymers that are able to absorb several times their own weight of water or body fluid. A suitable partially neutralised superabsorbent material may be comprised of a cross-linked polyacrylate of the kind described in EP 0,392,108, although other types of superabsorbent material that have corresponding properties may alternatively be used.

The term "lactic acid bacteria" and the abbreviation "LB" relate to a group of bacteria which produce lactic acid at normal fermentation. Examples of bacteria species that include strains belonging to this group are *Lactobacillus*, *Lactococcus*, *Leuconostoc* and *Pediococcus*. Bacteria of the families *Lactobacillus* and *Lactococcus* are preferred.

The term "CTMP" relates to chemithermomechanical pulp.

The Term "CP" relates to chemical cellulose pulp.

The term cfu relates to colony-forming units.

The invention will now be described with reference to the accompanying drawings, in which

Figure 1 shows an inventive diaper from that side which is intended to lie against the wearer in use;

Figure 2 is a stack diagram illustrating the cultivation of *Escherichia coli* in an absorbent article containing 1) CTMP + conventional superabsorbent; 2) CTMP + conventional superabsorbent + lactic acid bacteria; 3) CTMP + partially neutralised superabsorbent; and 4) CTMP + lactic acid bacteria + partially neutralised superabsorbent; and

Figure 3 is a stack diagram illustrating the cultivation of *Enterococcus faecalis* in an absorbent article that contains 1) CTMP + conventional superabsorbent; 2) CTMP + conventional superabsorbent + lactic acid bacteria; 3) CTMP + partially neutralised superabsorbent; and 4) CTMP + lactic acid bacteria + partially neutralised superabsorbent.

## DETAILED DESCRIPTION OF THE INVENTION

An absorbent article with which the problem associated with undesirable side effects, such as skin irritation and undesirable odours, is further reduced by combining in said article a pH-regulating substance in the form of a partially neutralised superabsorbent material, with lactic acid bacteria.

Swedish Patent Application 9702298-2 describes an absorbent article that includes a pH-regulating substance in the form of a partially neutralised superabsorbent material which when wetted produces in the absorbent article a pH in the range of 3.5-4.9. Such a pH value has been found to have a growth-inhibiting effect on undesirable microorganisms in the article. The activity of certain skin-affecting enzymes, such as lipases and proteases, is also impaired.

According to the invention, an absorbent body may also include absorbent material other than partially neutralised superabsorbent material. Cellulose pulp is an example of one

such material. It has been found beneficial to use a partially neutralised superabsorbent material according to the foregoing in combination with cellulose that has a pH below 7, and preferably below 6. A suitable cellulose pulp is chemithermomechanical pulp (CTMP) having a pH = 2.5-8.5, preferably 2.5-6.5, and most preferably 2.5-5.5. Another  
5 suitable pulp is chemical cellulose pulp that has a pH = 2.5-8.5, preferably 2.5-8.0 and most preferably 2.5-7.0.

The cellulose pulp can be given a suitable acidity by controlling the pH of the pulp during the manufacturing process, for instance by adding an acidifier. This acidifier may,  
10 for instance, be SO<sub>2</sub>-water. Alternatively, an appropriate acid may be added to the finished pulp.

As before mentioned, cross-linked superabsorbent polyacrylates suitable for use in the present invention are described in EP 0,391,108. Other superabsorbent materials having  
15 the same properties as those aforesaid may also be used. A suitable proportion of superabsorbent material in the article is 5-100%, preferably 15-60% and most preferably 15-50%.

SE 9702298-2 describes the relationship between the degree of neutralisation and the pH  
20 of the aforesaid superabsorbent material. It is evident that the degree of neutralisation will preferably be between 20% and 45%, and more preferably between 20% and 35%.

The diaper 100 shown in Figure 1 includes a liquid-permeable casing sheet 1 made, for instance, of nonwoven material or of perforated plastic film, a liquid-impermeable casing  
25 sheet 2, made for instance of plastic film or hydrophobic nonwoven, and an absorbent body 3 enclosed between said casing sheets 1, 2.

The diaper is intended to embrace the lower part of the wearer's trunk in the form of a pair of absorbent underpants. Accordingly, the diaper includes two end parts 4, 5 and a  
30 narrower crotch part 6 between said end parts, said crotch part being intended to be placed between the thighs of the wearer in the crotch region when in use. The diaper

includes fastener tabs 7 close to the rear waist edge 8 of the diaper, so as to enable the diaper to be secured in the desired pants-like configuration. In use, the fastener tabs 7 are fastened to the front part 5 of the diaper, close to the front waist edge 9, so as to hold the diaper together around the wearer's waist.

5

The diaper shown in Figure 1 also includes prestretched elastic devices 10, which may consist of elastic tape, wire covered elastic threads, elastic foam or some other suitable material. For the sake of simplicity, the elastic devices 10 have been shown in a stretched state in Figure 1. As soon as the tension in the elastic devices is released, the devices will contract and therewith form elastic leg openings on the diaper.

10

The absorbent body 3 of the diaper embodiment shown in Figure 1 is comprised of two layers 11, 12, to wit an upper liquid acquisition layer 11 and a lower liquid storing and liquid dispersing layer 12. The upper acquisition layer 11 shall be capable of receiving large volumes of liquid over a short period of time, i.e. shall have a high instantaneous liquid absorption capacity, whereas the lower liquid storing and dispersing layer 12 shall have a high liquid dispersion capacity and shall be able to drain liquid from the acquisition layer 11 and disperse this liquid in the storage and dispersion layer 12. The differences in the respective properties of the two layers 11 and 12 can be achieved by arranging for differences in density, wherewith a more densely compressed fibre structure will disperse liquid more effectively than a corresponding fibre structure of lower density, which as a result of its larger pore size has a higher instantaneous liquid absorption capacity and a lower liquid dispersion capacity. Differences in the absorption capacity of the two layers can also be achieved with the aid of different fibre structures that have mutually different properties. For instance, chemically produced cellulose fluff pulp has a higher liquid dispersion capacity than, e.g., pulp that is produced mechanically or chemithermomechanically, so-called CTMP. A fibre structure that contains chemically stiffened cellulose fibres will also have a higher liquid absorption capacity but lower liquid dispersion capacity than conventional chemical pulp. Natural fibre wadding or fluffy nonwoven material are examples of other materials suitable for use in the acquisition layer 11.

20

25

30



A pH-lowering substance in the form of a partially neutralised superabsorbent is mixed in with the upper liquid acquisition layer 11 of the absorbent body 3. This part of the absorbent body 3 also includes lactic acid bacteria.

5

A partially neutralised superabsorbent that functions as a pH-regulating substance has a lower total absorption capacity and a slower absorption rate than conventional superabsorbent. One advantage with placing such a superabsorbent in the upper part of the absorbent body closest to the wearer is that the risk of swollen superabsorbent lumping together is reduced in this way. A common problem is so-called gel blocking caused by clumping of swollen superabsorbent. Gel blocking implies that when the superabsorbent is wetted it forms a gel that blocks the pores in the porous structure and therewith impedes the transportation of liquid from the wetting region to other parts of the absorbent structure.

15

A conventional superabsorbent is mixed in the lower liquid storage and liquid dispersion layer 12 of the absorbent body 3. One advantage afforded by placing conventional superabsorbent in the lower liquid storage layer 12 is that a conventional superabsorbent has a higher total absorption capacity than a partially neutralised superabsorbent that has a pH-regulating effect.

20

It will be understood that the invention also includes other absorbent body constructions. The absorbent body may include both partially neutralised superabsorbent and conventional superabsorbent, both of said superabsorbents being distributed uniformly in both the upper layer and the lower layer of the absorbent body. Furthermore, it is feasible to use only one type of superabsorbent material in addition to cellulose fluff pulp. In such cases, the superabsorbent material has the form of a superabsorbent which will also function as a pH-regulating substance.

25

Layers other than the liquid acquisition layer 11 in the absorbent body 3 may also include lactic acid bacteria, and it is also feasible to include lactic acid bacteria on/in the liquid permeable casing sheet of said article.

- 5 The invention will now be described with reference to the following example, which is given for illustration purposes only and which has no limiting effect on the invention.

### Example

- 10 Tests were carried out while using sterile synthetic urine that included a microorganism growth medium. The synthetic urine contained monoions, divalent ions, cations and anions and the urine was prepared in accordance with information contained in Geigy, Scientific Tables, Vol. 2, 8th Ed., 1981, page 53. The microorganism growth medium was based on information concerning Hook and FSA media for enterobacteria. The  
15 mixture had a pH of 6.6.

- Absorbent bodies were produced with the aid of a slightly modified sample body former according to SCAN C 33:80. Fluff pulp and superabsorbent material of a desired type were weighed-up and a uniform mixture of fluff pulp and superabsorbent material then  
20 passed in an air stream at a subpressure of about 85 mbar through a tube having a diameter of 5 cm and provided with a metal bottom net on which thin tissue had been placed. The mixture of fluff pulp and superabsorbent material was collected on the tissue on the metal net and formed the absorbent body. The absorbent body was then weighed and compressed to a bulk density of 6-12 cm<sup>3</sup>/g. The absorbent bodies contained 0.85 g  
25 CTMP and 0.15 g superabsorbent material. Two different superabsorbents were used, these being conventional superabsorbent having a pH of about 6 and partially neutralised superabsorbent having a pH of about 4.2. In the event of using lactic acid bacteria, these bacteria comprised *Lactobacillus plantarum*, strain LB931, which had been deposited at Deutsche Sammlung von Mikroorganismen (Braunschweig, DE) and given the  
30 deposition number DSM 11918. LB931 was freeze-dried in skimmed milk. The bacteria

concentration was adjusted to  $10^9$ - $10^{10}$  cfu/gram, by mixing the bacteria with powdered skimmed milk.

Absorbent bodies were prepared in accordance with the above method. Synthetic urine  
5 was prepared in accordance with the foregoing. *Escherichia coli* (E.c.) and  
*Enterococcus faecalis* (E.f.) were cultivated in nutrient broth (Nutrient Broth Oxoid  
CM1) overnight at a temperature of 30°C. The graft cultures were diluted and the bacteria  
contents calculated. The cultures were mixed in different proportions, so that the final  
culture mix contained about  $10^4$  organisms per ml of synthetic urine. 10 ml of the  
10 synthetic urine were poured into a sterile sputum jar 70.5 x 52 mm, volume 100 ml, and  
the absorbent body placed upside down in the jar and allowed to absorb liquid for a  
period of 5 minutes, whereafter the jar was turned and incubated at 35°C for 0, 4, 8 and  
12 hours respectively, whereafter the bacteria count in the absorbent body was  
determined. TGE agar was used in the cultivating process for measuring the total number  
15 of bacteria, and Drigalski agar and Slanetz Bartley agar were used for specific  
measurement of *Escherichia coli* and *Enterococcus faecalis* respectively. LB931 was  
calculated on MRS agar (de Man Rogosa Sharpe). When LB931 was added to the  
absorbent body, it was added in an amount corresponding to 10 mg of the freeze-dried  
mixture mixed with 10 ml synthetic urine, which was then added immediately to the  
20 sample body.

The results of these tests are listed in the following table:

Bacteria growth in absorbent articles with or without partially neutralised  
25 superabsorbents and lactic acid bacteria respectively.

I. *E. Coli*:

5	Type of absorption body	0h	4h	8h	12h
		log cfu/ml	"	"	"
	CTMP + SAP	3.7	5.3	9.2	9.4
	CTMP +SAP + LB	3.8	5.3	9.0	9.4
	CTMP + acid SAP	3.7	4.7	7.8	9.0
	CTMP + acid SAP + LB	3.5	4.5	5.6	5.7

II. *Enterococcus faecalis*:

10	Type of absorbent body	0 h	4 h	8 h	12 h
		log cfu/ml	"	"	"
	CTMP + SAP	3.9	5.6	8.3	8.3
	CTMP +SAP + LB	3.9	5.4	7.2	7.5
	CTMP + acid SAP	3.9	4.7	6.1	7.4
15	CTMP + acid SAP + LB	3.9	4.4	4.6	4.6

## III. LB931:

20	Type of absorbent body	0 h	4 h	8 h	12 h
		log cfu/ml	"	"	"
	CTMP + SAP + LB	7.7	7.8	8.4	8.5
	CTMP + acid SAP + LB	7.5	7.9	8.5	8.7

Partially neutralised superabsorbent is designated "acid SAP" in the above table.

It will be evident from the table that the combination of partially neutralised superabsorbent and lactic acid bacteria has a synergistic effect with regard to the reduction in the growth of *Escherichia coli* and *Enterococcus faecalis*. The division III in the above table also shows that LB931 grow equally as well in the presence of partially neutralised superabsorbent as in the presence of conventional superabsorbent.

These results are also shown in Figures 2 and 3.

## CLAIMS

1. An absorbent article that includes a synergistic combination of  
a) a pH-regulating substance in the form of a partially neutralised superabsorbent  
5 material, and

b) lactic acid bacteria,  
where the pH value of said article after being wetted and when worn against the skin lies  
in the range of 3.5-5.5, preferably in the range of 3.5-4.9, and most preferably in the  
range of 4.1-4.7.

2. An absorbent article according to Claim 1, **characterised** in that said article  
includes at least one further absorbent material.

3. An absorbent article according to Claim 2, **characterised** in that the material  
15 includes chemithermomechanical cellulose pulp (CTMP).

4. An absorbent article according to Claim 2 or Claim **characterised** in that the  
article includes chemical cellulose pulp (CP).

20 5. An absorbent article according to any one of Claims 1-4, **characterised** in  
that said lactic acid bacteria belong to the *Lactobacillus* family.

6. An absorbent article according to Claim 5, **characterised** in that said lactic  
acid bacteria belong to the *Lactobacillus plantarum* strain LB931, said strain having been  
25 deposited at Deutsche Sammlung von Microorganismen (Braunschweig, DE) and there  
given the number DSM 11918.

7. An absorbent article according to any one of Claims 3-6, **characterised** in  
that the pH of the cellulose pulp has been lowered by adding an acidifier during the pulp  
30 manufacturing process.

8. An absorbent article according to any one of Claims 2-7, **characterised** in that the article includes a casing-enclosed absorbent body which includes an upper liquid acquisition layer (11) that includes partially neutralised superabsorbent material intended to lie proximal to the wearer in use, and a lower liquid storage and liquid dispersion layer  
5 (12) which includes conventional superabsorbent material and which is intended to lie distal from the wearer in use.

9. An absorbent article according to any one of Claims 1-8, **characterised** in that the number of lactic acid bacteria in the article is  $10^4$ - $10^{11}$  cfu.

10

10. An absorbent article according to Claim 9, **characterised** in that the number of lactic acid bacteria in the article is  $10^6$ - $10^{10}$  cfu.

1/2

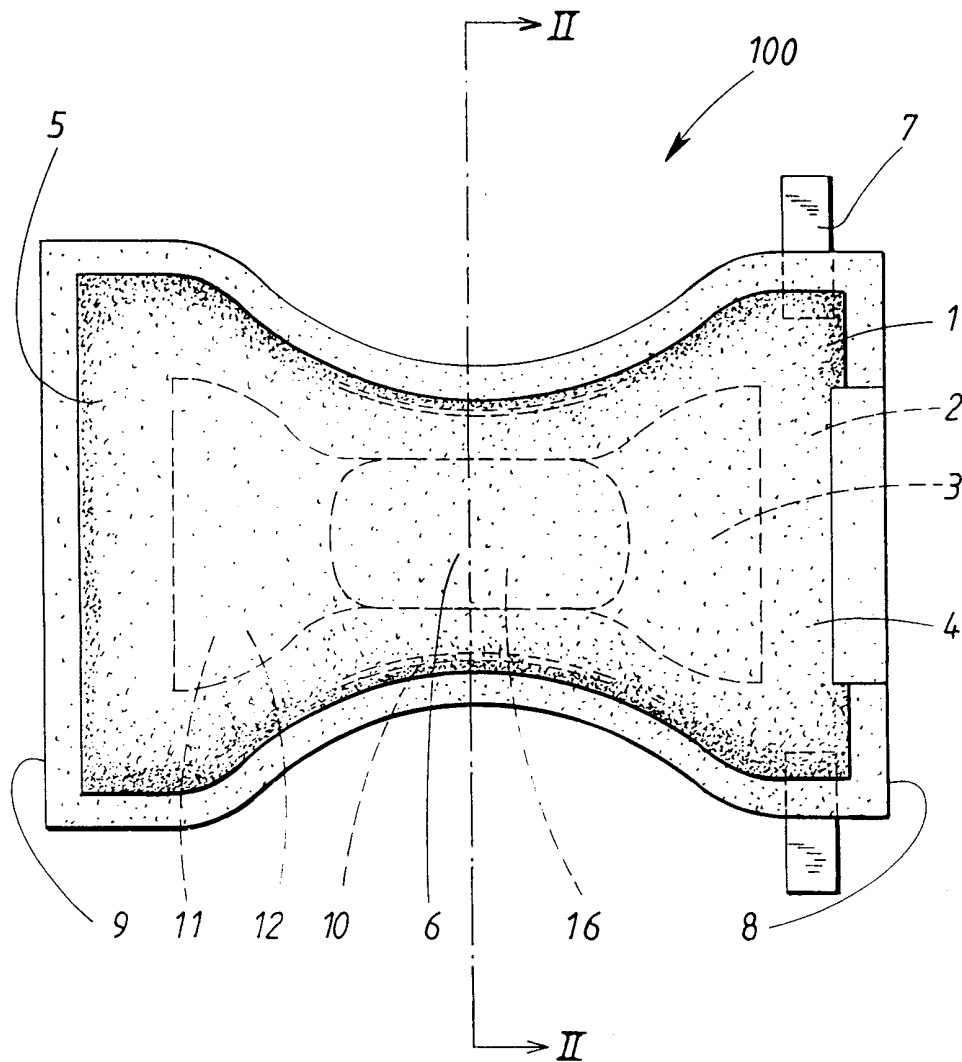


FIG. 1

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Fig. 2

## Cultivation of E-coli

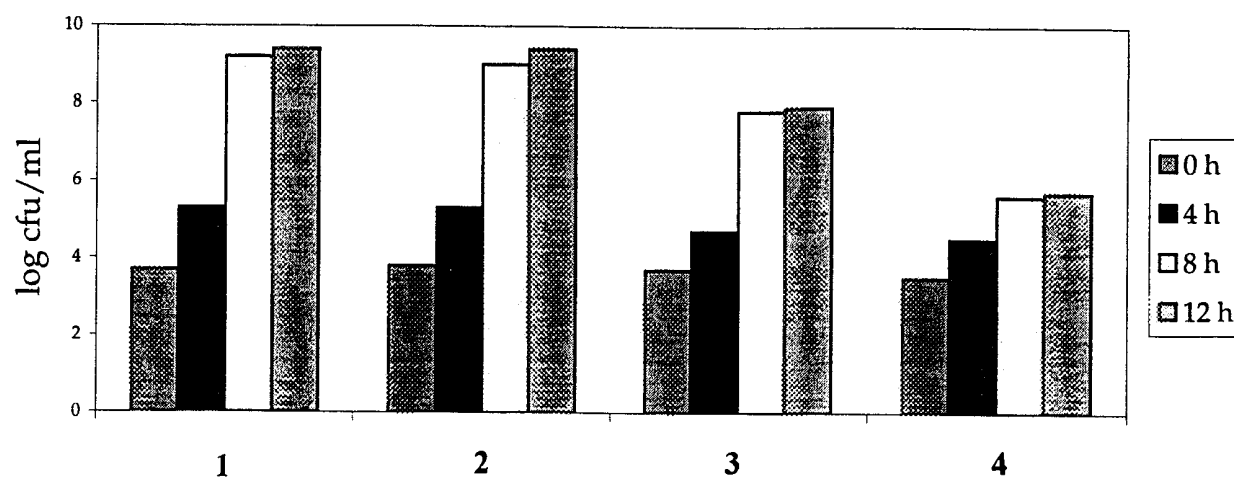
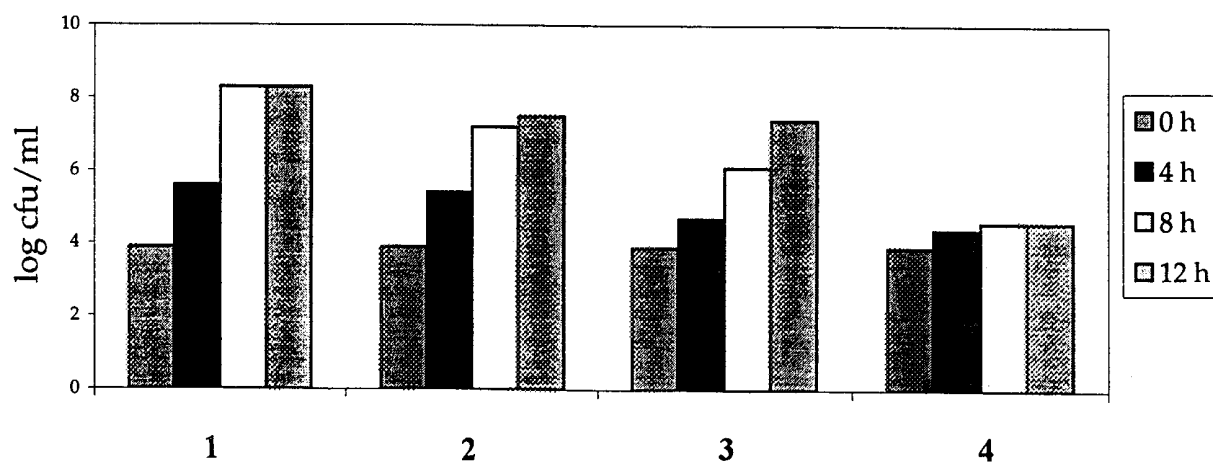


Fig. 3

## Cultivation of Ent. Faecalis





## INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE 99/02369

## A. CLASSIFICATION OF SUBJECT MATTER

IPC7: A61L 15/36, A61L 15/46, A61L 15/60

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)

IPC7: A61L

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)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

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A	WO 9702846 A1 (SCA MÖLNLYCKE AB), 30 January 1997 (30.01.97)  -- -----	1-10

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

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## INTERNATIONAL SEARCH REPORT

Information on patent family members

02/12/99

International application No.

PCT/SE 99/02369

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