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FERMENTING PROCESS

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The present invention relates to a new general method of fermenting starches, sugars and various materials inclusively cellulose-like substances hydrolised or not, the fermentation being principally but not exclusively lacto-butyric, by means of a bacteria symbiose obtained by the conjugated use of various selected species added to the bacterias of the earth and the alimentary canal of certain herbivorous animals, under others that of the Panda (*B. pandae*) exotic animals which eat bamboo-cane. On this way produces higher than that given by other processes are obtained and are conditioned by the biological characteristics and by the composition of said ferment substances especially by the presence of cellulosolytic anaërobes as well as by the operative manner which sets them to action.

In fact,

(*a*) One incorporates to said ferment substances, by suitable means and culture manners, certain selected bacterias, lactic, pseudo-lactic, butyric, cellulosolytic, pectinolitic, etc., taken from habitats which are their propers, nature, man, animals. There is given a place to the Pandae Bacterias, especially insulated and to the cellulosolytic species as well as to certain sarcines derived from plants and from dead wood. The so prepared ferment substances allow to make fermenting besides sugars and starches other substances contained in various primary substances as for instance the brans and wastes of various corns or the hydrolysates of cellulosic substances containing, besides the reducing sugars, gums, mucilages, resins, dextrines, hemicelluloses, not hydrolized celluloses, etc., as well as certain organic salts obtained by saturation of the acids present in said hydrolisates. The fermentations by these ferment substances, of the primary substances indicated herebefore are characterized by produces higher than given by only the transformation of starches or reducing sugars.

(*b*) Further the composition of these ferment substances allows to direct the bacteria activity towards obtaining various products and also, in the course of the same fermentation, to stop it at the desired phase or to continue it eventually in a later phase. As an example one indicates here the operating manner for obtaining first the lactic fermentation, butyric in the continuation, of troubled musts of the hydrolysis of cellulose-like substances.

After sowing the musts into the first phase, the lactic properly said, the pH is maintained at about 5,5 by successive additions of calcium carbonate, the temperature resting at about 50° C. When the desired final product is lactic-acid at this phase the fermenting is stopped and the solution of calcium lactate is concentrated and let crystallize and separated by filtration, airing or by any other known means.

When the desired finished products are the fatty volatile acids one proceeds to go to the second phase of the fermentation, in adding the must of a sufficient quantity of celcium-carbonate for maintaining the pH during all the duration of the fermentation between 7 and 7,5, the temperature being lowered until about 40° C.

This manner of operating consists therefore in making vary the conditions of the fermentation (concentration of the primary substance pH, cooperating temperatures, manner of acclimature in view of obtaining various products, for inst. be it lactic acid or fatty volatile acids in "tampion" condition, be it alcohols, acetone and acids, in acid condition.

Further the special composition of the ferment substances allows to draw a maximum profit in various products starting of complex primary substances.

In fact this fermentation which can clear in troubled must allows to render more economical and easy the employing of certain substances like the cellulosic residues, the wastes in the manufacture of meal, rize, oil, etc.

In a general manner these ferment substances allow a very active fermentation of the primary substances used. Their acclimation to those substances is particularly rapid. In comparison with the known industrial methods of butyric fermentation the new symbiose reduces the duration of the fermentation, even in the most difficult cases and increases for about 20% the profits. It supports more easily in the musts the presence of antiseptics which is difficult to integrally eliminate from the hydrolisates.

When in the preparation of the ferment substances the mingling of the bacterias from the diverse origins is once realized according to the process the stocks are constantly maintained in the active stage by frequently repeating setting of reserves, in mixed media, of nitrogenious and cellulosic sugars according to a manner of operating which puts to account products of fermentation desired to be obtained and primary substances desired to be treated.

For indicating but not for limiting purposes an example of sowing a raw hydrolysate of cellulose-like substances in view of obtaining fatty acids is given hereafter.

The chosen special ferment substance which,

as has been said, contains, besides other kinds, the cellulosolytic anaërobies constantly made active again, is first prepared in a culture container containing one litre of must to 10% of determined substances capable of being fermented and the necessary quantities of nourishing substances as well as the carbonate of calcium are added, this latter serving for neutralizing arising acids. The fermentation begins after a few hours. This first ferment substance will only serve the third day for sowing about 1½ litres of a second ferment substance prepared with the raw hydrolysate of cellulose-like substances. This must from which the insoluble (lignin) has not yet been separated contains for instance 70 gr. per litre of sugar reductives (principally glucose, manuose, xylose) other not reductive substances adapted to be fermented (dextrines, gums, celluloses, hemieelluloses, etc.) and quantities of diverse acids (acetic, formic, levulic, ulmic, etc.) and even traces of antiseptic substances as for instance the furfurol which is very difficult to be fully eliminated from the cellulose-like hydrolysates.

To this must, on its side, are added carbonate of calcium and, according to the case, chemical adjuvants. The litre of the first ferment substance has thus served for sowing 1½ litres of musts of hydrolysis, as here-above, for provoking the fermentation of the sugars and of other substances which are more especially transformed by the cellulosolytic anerobies present in the stocks. As has been said these stocks are industrially prepared and made active by heating and frequently repeated setting of reserves, in mixed mediums (cellolosic, sugared, nitrogenous). At the expiration of four days of fermentation these 2½ litres of mixed ferment substances can be poured into 7½ litres of new sauce of hydrolysis prepared as precedently. One has therefore in the whole 10 litres of must constituted by 25% of acclimated ferment substance and 75% of raw hydrolysate designed for the fermentation. These proportions are valuable for all industrial quantities.

The fermentation of the totality of the musts finishes at the expiration of six days.

As already stated the lacto-butyric fermentation operates without taking account of the intermediate phases, in two times the first of which gives over all the lactic acid according to the formula $C_6H_{12}O_6=2C_3H_6O_3$ and the second gives the fatty volatile acids according to the formula hereafter (expressed in butyric acid)

$$2C_3H_6O_3=C_4H_8O_2+2CO_2+2H_2.$$

In industrially operating as has been said as an example, upon the hydrolysis sauce of the cellulose-like substances and by sowing 25% of ferment substance, the total duration of the fermentation will be five to six days, instead of eight to nine days with the ferments of the earth. In proceeding as said hereabove, that is, by successive sowing, after four days of fermentation only, that is, in butyric phase, one obtains the 25% of acclimated ferment substance at a very advanced degree permits a rapid fermentation of the musts which is finished in five or six days.

There are given, by way of example, a few profit numbers for a sauce of hydrolysis for oil-graves.

Sowing with 10% of ferment substance (butyric bacteries of the earth)

Duration of the fermentation ..... 15 days
100 kgs of reductive sugars give in butyric acids ..... 55 kgs 500
With a profit % of the theory of 113,5%

Sowing with 25% of ferment substance (butyric bacteries of the earth)

Duration of the fermentation ..... 8 to 9 days
100 kgs of reductive sugars give in butyric acid ..... 57 kgs 100
With a profit % of the theory of 117%

Sowing with 25% of ferment substance (with the new acclimated ferment substance)

Duration of the fermentation ..... 5 to 6 days
100 kgs of reductive sugars give in butyric acid ..... 68 kgs 400
With a profit % of the theory of 140%

The theoretical profit in $C_4H_8O_2$ is of 48,9% of the reductive sugars. In the cited examples the higher profits with respect to the reductive sugars indicate therefore that other substances, contained in the hydrolysate, have been transformed by the bacteries made active according to the process. It results therefrom that the real profits largely exceed the theroetical profits which were to be predicted in the case where only the reductive sugars present in the musts would have gone through the fermentation.

The hydrogen and the carbonic acid of the fermentation can be recuperated and utilized for diverse industrial operations.

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