United States Patent Office 2,940,858 Patented June 14, 1960

2,940,858

METHOD OF MAKING FODDER FROM CHOPPED STRAW

Alfred Flechsig, Zwonitz, Germany, assignor of one-half to Paul O. Tobeler, doing business as Trans-Oceanic, Los Angeles, Calif.

No Drawing. Filed Oct. 31, 1957, Ser. No. 693,507

1 Claim. (Cl. 99—9)

The present invention relates to new and improved process for manufacturing fodder or edible foodstuff from straw.

In order to completely understand the invention, it is necessary to understand something of the nature of straw. It is well known that straw is substantially undigestible as it is obtained from various agricultural processes. The reason for this lies primarily in the fact that straw itself is composed of a plurality of individual cells, each of these cells containing interior nutrient material surrounded by a cell wall. Such cell walls are composed of a complex mixture of various chemical ingredients, such as, for example, lignins and pantosans and cellulose products bound together by these lignins and pantosans. Those skilled in the art to which this invention pertains will realize that the term "lignin" is employed as a generic term to designate a large number of cellulose-like substances, such as lignose, lignone and the like. Those skilled in the art to which this invention pertains will further realize that the term "pantosans" relates to a group of gum-like or resin-like materials which are frequently referred to as hemi- or presdo-celluloses. In order to get at the nutrient material within a cell structure in straw, it is necessary to weaken and to destroy as by various degradation reactions the cell wall structures encountered.

A number of prior processes have been developed for this purpose. The prior processes upon which this invention can be said to be based involved the digestion of straw with an alkaline material such as, for example, caustic soda or the like in water. Such alkaline solutions will tend upon heating to break down the cell walls in straw. These prior processes tend to result in relatively tasteless products which are deficient in vitamin content and the like. In order to remedy this deficiency, it has been proposed in the past to add to the product of such alkaline digestion of straw various nutrient materials such as molasses, such nutrients serving in some cases to neutralize the caustic employed during digestion.

Caustic digestion processes of the category briefly indicated in the preceding paragraph are considered relatively unpredictable because of a large number of factors. One of these is the variation in the cell wall structure in different types of straws and even in straws obtained from different sources. Because of such variations and other factors, the reactions accompanying the treatment of straw in a caustic bath are difficult to control accurately so as to obtain precisely the desired products. In many cases the digestion treatment employed with this prior type of process results in the nutrient compounds in the straw being degraded to water soluble materials. Such water soluble materials may, in many cases, be lost.

An object of the present invention is to provide a new and improved process for manufacturing fodder from straw. It will be realized that the term "fodder" utilized herein is of a generic category. Thus, if desired, the word "foodstuff" may be substituted for this term throughout this specification. The process of the present invention is designed so as to produce a product which has a

high nutrient content and which has an acceptable taste so that it is readily accepted by cattle for feeding purposes. Because of the nature of this invention, it is not considered necessary to set forth in this specification a further long listing of various objects and advantages of it. Those familar with the field to which the invention pertains will recognize a number of other objects and advantages of the invention from a detailed consideration of this specification and the appended claims.

In order to understand the process of the invention it may be stated in essentially summary form that it involves the modification of an existing process for producing fodder from straw by the addition of yeast to a bath containing straw, water and an alkaline inorganic compound after such a mixture has been heated to a sufficient extent so as to partially cause degradation of the lignin and pentosan structures within the cell walls of the straw and heating the mixture containing this yeast until plasmolysis of the yeast is obtained. Such yeast serves a number of purposes as will be hereinafter described in more detail. The process also involves a further step of neutralizing the final mixture obtained after heating yeast in the presence of straw, water and an alkaline inorganic compound, and the removal of water from the neutralized mixture so as to obtain a product which may be satisfactorily transported and may be easily fed to cattle. It may also be stated in essentially summary form that the invention concerns a product produced by a process as briefly indicated.

The initial raw material employed by the process of this invention is straw. The term "straw" as employed here is to be interpreted broadly and is to be considered as encompassing various straws obtained from wheat, oats, etc., as well as a number of other chemically related materials having a similar cell structure. In order to promote as complete a reaction as possible in the process of this invention, it is preferred to chop the raw material utilized into finely divided particles by established techniques. In general, the more complete the division of the initial material, the more complete and uniform the reactions obtained during subsequent operations of the process.

The first of these subsequent operations involves mixing chopped straw with water and inorganic caustic compound. Sufficient water is preferably utilized so as to completely cover the reaction mixture. The amount of caustic employed may be varied within wide limits depending upon the speed of the reaction desired, the specific aqueous caustic bath employed, and the temperature to be used for digestion. In general, the reactions obtained and the time required will be promoted or shortened respectively by employing either large quantities of caustic and/or comparatively strong caustics. Those skilled in the art to which this invention pertains will be able to readily determine by routine experimentation what caustics and what concentrations of these caustics can be most satisfactorily employed for any particular type of straw. It may be stated, however, that such inorganic caustics as sodium hydroxide, calcium hydroxide and the like may be employed.

After a mixture is formed of chopped straw, water and caustic as indicated above, this mixture is treated at an elevated temperature until the lignins and pentosans in the cell wall structure of the straw being treated is attacked or broken down to a substantial extent. This initial digestion is preferably not carried to the point that the cell wall structure of the straw is completely degraded. Because of the chemical complexity of the reactions occurring, it is considered impossible to specify in more detail the time required for this step. This step is, however, inter-related with heating the reaction mixture in the presence of yeast as will be explained so that both

of these steps result in substantially completely breaking down the cell wall structure. In general, the more elevated the temperature employed by this initial treatment, the more rapid the results obtained. It is preferred to carry out this initial digestion with a temperature of at least 180°; preferably the temperature of steam at atmospheric pressure (approximately 212° F.) is utilized.

Following the first digestion step indicated above, yeast of the family saccharomyces is added to the reaction mixture. Those skilled in the art will realize that all of the yeast within this family, such as for example, S. ellipsoideus, S. piriformis, S. pombe and S. mellacei can be utilized. Certain of these yeasts normally are found in conjunction with various bacteria, and such bacteria are, of course, normally killed by the digestion process carried out with the yeast as part of the reaction mixture. It is normally preferred to utilize with this invention in what is commonly termed "beer" yeast inasmuch as this particular composition is readily available, is cheap and has a high nutrient value. The quantity of yeast utilized with the invention may be varied within wide limits. It is preferred to use sufficient yeast so that the yeast will result in a desired product having a desired nutrient content for any particular final use as a foodstuff. Also, sufficient yeast should be added in sufficient amount so that this yeast appears to affect the reactions obtained during the treatment of the reaction mixture containing yeast so as to prevent the formation of unwanted degradation products of nutrient material within the straw employed.

The temperature of the second digestion step, which in actuality is really a continuation of the initial digestion, is preferably the same as that employed for the initial digestion of a mixture containing only straw, caustic and water. If desired make up water and additional caustic may be added during the addition of the yeast so as to promote or speed up the reactions obtained.

During the digestion or cooking in the presence of yeast, the yeast, itself undergoes plasmolysis as the various lignins and pentosans within the cell wall structures of the initial straw are degraded so as to expose nutrients in the straw to the reaction mixture. Apparently the yeast serves during this stage of the process to prevent the formation of unwanted degradation products from the nutrient materials within the cell walls of the initial straw. The plasmolysis of the yeast apparently tends to result in the formation of intermediate products within the reaction vessel employed which tend to neutralize the caustic utilized for the digestion, and, hence, to effect the speed or rate of attack of the nutrient material within the straw by the caustic employed. It is specifically to be noted that during the plasmolysis of yeast during the second digestion step, the vitamin and other nutrient content of the yeast employed is apparently not affected, and these nutrients remain in the final product obtained so as to be available for use in feeding. The limiting time as to the second digestion step is considered to be the time required so as to effect substantially complete plasmolysis of the yeast without effecting a breakdown of the chemical compounds within the yeast which are valuable for feed purposes. This time apparently coincides with the time required to prevent unwanted degradation of the nutrient materials within straw.

Following these operations the reaction mixture obtained may be readily neutralized in accordance with established techniques of any common mineral acid, such as, for example, hydrochloric acid; preferably the neutralization is carried out so as to achieve a pH of from about 6 to about 8 since cattle apparently do not object to foodstuff having a pH within this range. In order to make this product acceptable for use as a foodstuff and in order to make it inexpensive to transport, it is normally desired to remove water from it by various techniques. One preferred method of doing this is by heating the product obtained at a temperature slightly over the boiling point of water, such as a temperature of from 212° F. to 250° F. This heating, if carried out in extremely elevated temperatures, will, of course, result in undesired reactions impairing the value of the product obtained. Also if an extremely elevated temperature is employed in heating, some of the volatile compounds having a nutrient value will apparently tend to be driven off of the product obtained. If desired, the product may be dehydrated completely so that it may be sold in sacks, etc.

In order to complete this specification the following specific example of the process of this invention is set forth. It is to be understood that this specific example is given by way of illustration only and is not to be taken as limiting the invention in any respect. Obviously the procedure set forth in this example may be altered within comparatively wide limits without departing from the essential features of this invention.

Example

One hundred pounds of finely divided or chopped straw was placed in wooden tank containing steam tubes in approximately three equal layers; 1.6 lbs. of sodium hydroxide were positioned between each of the three layers of the straw. The tank was then heated for a period of one hour at 212° F. through the use of steam supplied through the tubing. At the end of this period 60 lbs. of water was added and the mixture was boiled for another hour. After this, the entire reaction mixture was cooled. After it had reached a temperature of 40° C. a lime-yeast mixture containing 10 lbs. of quick lime, 25 lbs. of water and 3 lbs. of dry beer yeast was added to the entire reaction mixture and the resulting mixture was stirred. An additional 25 lbs. of water was then added. The entire mixture created as a result of these operations was then cooked through the use of steam at 212° F. for a period of two hours. After this was done, the reaction solution or mixture was neutralized with hydrochloric acid to a pH of about 7. In general, about one cubic centimeter of concentrated hydrochloric acid is required per kilogram of reaction solution in order to affect neutralization. The so-neutralized mixture was then dried to a moisture content of about 20%–23% by heating it at a temperature of from about 212° to 250° F.

I claim:

A process for manufacturing fodder from chopped straw which comprises: heating a mixture of chopped straw, water and sodium hydroxide at a temperature of 212° F. for a period of two hours so as to partially break down the cell wall structure within said straw, adding beer yeast, water and quick lime to the so-heated mixture; heating the resulting mixture at a temperature of 212° F. for a period of two hours so as to plasmolyze said yeast and so as to break down the said cell wall structure within said straw; neutralizing the reaction mixture containing said yeast with hydrochloric acid to a pH of from about 6 to 8; and removing water from said neutralized mixture.

References Cited in the file of this patent

UNITED STATES PATENTS

854,791	Ahlers	May 28, 1907
1,442,322	Beckman	Jan. 16, 1923

FOREIGN PATENTS

21,708	Great Britain	1912

OTHER REFERENCES

Jukes: American Brewer, June 1941, pp. 40–43.