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[54] **Title:** PROCESS OF PRODUCING ANIMAL FEED FROM CASSAVA FIBER RESIDUE

[75] **Inventor (s):** CHAY BINH PHAM, of Los Baños, Laguna, Philippines

[73] **Assignee (s):** NONE

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[57] A B S T R A C T

This invention relates to the microbial transformation of Cassava fiber residue which is a waste from the cassava starch processing plant into animal feed which has high protein content, high digestibility value, high vitamins, and high probiotics using the solid state fermentation.

The present solid state fermentation process involves the use of the inoculant, lactobacillus acidophilus on the fermented substrate to obtain a product which contained high protein and probiotics which could be directly used to feed cattle, goats, swine, chicken, ducks, and etc.

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Examiner: F. O. Bulilan .....

Attorney / Agent: .....

ABSTRACT OF THE DISCLOSURE

This invention relates to the microbial transformation of cassava fiber residue which is a waste from the cassava starch processing plant into animal feed which has high protein content, high digestibility value, high vitamins, and high probiotics using the solid state fermentation.

The present solid state fermentation process involves the use of the inoculant, lactobacillus acidophilus on the fermented substrate to obtain a product which contained high protein and probiotics which could be directly used to feed cattle, goats, swine, chicken, ducks and etc.

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PROCESS OF PRODUCING ANIMAL FEED FROM CASSAVA FIBER RESIDUE

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This invention relates to the microbial transformation of cassava fiber residue which is a waste from the cassava starch processing plant into animal feed which has high protein content, high digestibility value, high vitamins, and high probiotics using the solid state fermentation.

The Philippines at present is importing soybean meal and fish meal for use as protein ingredients in animal feeds. This country is a hard dollar earner from the agricultural sector and this results in the limited importation of these ingredients. Therefore, the Philippines is acutely deficient in protein for the animal body. However, it has an abundant supply of carbohydrates. The rapid growth in animal as in man is ensured by a balanced diet. The five major nutrients needed by animals are : protein (20-40%), fat (5-10%), carbohydrate (25-50%), vitamins and minerals.

Cassava fiber residue (cassava pulp) is the residue material waste which contains high carbohydrate (92%), low protein (1 to 2%) and high fiber (26%). Therefore, cassava pulp has extremely low nutritional value for animal feed. The technologies for bioconversion of solid-wastes has been invented. Carbohydrate conversion of cassava pulp to 25-45% protein was obtained. The high protein and modified natural structure of lignocellulosic fermented product could be used either for ruminant animals, poultry and swine. Probiotics provided from Lactobacilli in animal nutrition and health are to prevent diarrhea, minimal clostridial activity, increased nutrient digestibility and eliminate the use of antibiotics in animals.

This invention was developed for the simultaneous bioconversion of carbohydrate into protein and probiotic products in the same batch of solid state fermentation. The product has a moisture content of about 45-50% and can be fed directly to animals.

PROCESS DESCRIPTION

1. Treatment of raw materials

Cassava fiber residue (cassava pulp) is a waste material obtained from a cassava starch plant. It has about 70% moisture content.

Wet cassava pulp was dried in a ventilated hot air-dryer at 90°C overnight and the dried cassava pulp had 8-10% moisture content. This aimed to prevent the spoilage, and easy transportation to another place before doing the fermentation process.

In a cassava starch extraction plant equipped with the facilities for the fermentation process, wet cassava pulp could be used directly in the preparation of substrate for the fermentation process.

2. Preparation of inoculum or seed.

Inoculum was prepared by inoculating Aspergillus niger into the seed medium, which had the following composition (% by weight): ammonium sulfate, 1.5; table sugar, 1.5; mature coconut water as a diluent and pH 6 to 7. The inoculated seed medium was incubated on a shaker at room temperature for 24 hours.

3. Inoculation of substrate

Fermentation medium had the following composition (%): ammonium sulfate, 17; urea, 3; table sugar, 0.5; KH_2PO_4, 3.5; water as a diluent, and pH adjusted to 3.

Dried cassava pulp was mixed with the fermentation medium to establish moisture content of 45%. The mixture-substrate can be used directly in the inoculation step, or sterilized at 121° C for 15 min and then cooled to room temperature. The seed (10%) was used to inoculate the sterilized substrate-fermentation medium. The inoculated sterilized substrate-fermentation medium was mixed very well and spread on a perforated tray with 4 to 5 centimeters layer thickness of inoculated substrate.

4. Solid state fermentation process

The inoculated substrate was fermented in a ventilated incubator at 30-35°C until the substrate was covered by white filamentous fungi. The fermented substrate was well mixed and the fermentation process was extended for another day. Protein content of fermented substrate reached to 25-45% on dry basis.

The fermented substrate was inoculated with Lactobacillus acidophilus at concentration of 0.05%. The inoculated-fermented substrate was silaged at ambient temperature in a tank covered with plastic to prevent air infusion for at least one day. The product could be prolonged for one year.

The product which contained high protein and probiotics provided by Lactobacillus acidophilus could be directly used to feed cattle, goats, swine, chicken, ducks, and etc.

In case the process is carried out with wet cassava pulp, the fermentation powder medium had the composition as the following(%): ammonium sulfate, 17; urea, 3; table sugar, 0.5 and KH_2PO_4, 3.5; acid phosphoric acid, 0.01. The wet cassava pulp was well mixed with the powder fermentation medium to reduce moisture content of substrate to 55%. The mixture of substrate-fermentation medium can be used with or without the sterilization process at 121° C for 15 minutes.

The other process steps such as inoculation and fermentation were carried as mentioned above.

5. Drying and packaging

For convenient storage and transportation purposes, the fermented product was dried in a ventillated hot-air dryer at 70° C until mousture content was 7-8% in the final product. The plastic bag was used to prevent the absorption of moisture from theaatmosphere.

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WHAT I CLAIM:

1. A process of producing animal feed from cassava fiber residue (cassava pulp) which comprises the following steps:

   a) drying the wet cassava pulp discharged from the cassava extraction plant in a ventilated hot air-dryer at 90°C overnight or until 8-10% moisture content was achieved,

   b) preparing the inoculum medium which contains the following composition (% by weight): ammonium sulfate, 1.5; table sugar, 1.5; mature coconut water as a diluent and pH 6 to 7. The inoculum medium is sterilized at 121°C for 15 minutes,

   c) inoculating Aspergillus niger with the inoculum medium,

   d) shaking the inoculated seed medium on a shaker at room temperature for 24 hours,

   e) mixing the dried cassava pulp with the fermentation medium which contains the following composition (% by weight): ammonium sulfate, 17; urea, 3; table sugar, 0.5; KH_2PO_4, 3.5; water as a diluent and pH adjusted to 3, to establish moisture content of 45%,

   f) sterilizing the mixture of substrate-fermentation medium at 121°C for 15 minutes,

   g) inoculating the seed with the sterilized mixture at the rate of 10% of the weight of the mixture,

   h) spreading the inoculated mixture substrate on a perforated tray with 4 to 5 centimeters layer thickness,

   i) fermenting the inoculated mixture-substrate in a ventilated incubator at 30 to 35°C until substrate was covered by white filamentous fungi. The fermented substrate is well mixed and the fermentation process was extended for another day,

   j) inoculating Lactobacillus acidphilus with the fermented substrate at the rate of 0.05% of the weight of the fermented mixture,

   k) silaging the inoculated substrate fermented at ambient temperature in a tank covered with plastic for a least one day up to one year,

   l) drying the silage fermented product in a ventilated hot-air dryer at 70°C until moisture content of 7 to 8% in the final product was achieved,

   m) packaging the dried product in plastic bags to prevent the absorption of moisture,

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2. The process according to Claim 1 wherein step (f) is omitted, (excluded).

3. The process according to Claim 1 wherein step (a) is omitted and step (e) is modified as the following (e): mixing the wet cassava pulp with the powder of the fermentation medium which contains the following composition (% by weight): ammonium sulfate, 17; urea, 3; table sugar, 0.5; KH_2PO_4, 3.5; water as diluent and phosphoric acid, 0.01.

4. The process according to Claim 3 where step (f) is ommitted.

CHAY BINH PHAM
Inventor

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