NON – FOOD SWEETPOTATO PRODUCTS FOR INDUSTRIAL PRODUCTION AT UNIVERSITY OF EASTERN AFRICA, BARATON

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Abstract

The main aim of the paper is to report some practical non-food processing strategies for sweetpotatoes under study at University of Eastern Africa, Baraton (UEAB) in order to exploit the immense potential of the sweet potato (*Ipomoea batatas*) for industrialization and development. Results demonstrate this crop has unrivaled potential for value addition along the production, processing, marketing and utilization chain. Apart from the usefulness of tubers and leaves as food for both livestock and human beings, dried vines can be bound into decorative panel boards. This novel usage of the sweet potato will particularly benefit subsistence farmers in sweet potato growing areas to add value to the sweet potato by utilizing an otherwise rejected material, the vines. This would in turn raise the livelihoods of farmers through generation of extra income. As such, the main beneficiary would be the resource challenged African women living in areas where sweet potatoes are grown in sub – Saharan Africa. There is an indication that decorative panels can be bound by any commercial glue or that made from sweet potatoes. Good panels are produced from dried mature vines chopped into 2 cm pieces carefully mixed with an adhesive to make sure that each chip is in contact with the glue. The materials were placed between an improvised presser made of metal sheets 20 x 20 x 2 cm in size, one at the bottom and the other on top. To prevent the material from sticking on to the board, a thin layer of polythene paper was spread on the upper side of the bottom plate as well as the lower side of the top plate. The mixture was placed, first from the corners, followed by the edges, then to the center. The metal plates were placed between two wooden blocks and pressed with a two – tone car jack for 30 minutes before it was removed and placed in the oven for slow drying at 80^0C for 48 hours. The resulting product is the appended panel which can be used for decoration, a picture frame and wall hanging.

Key words: Sweetpotato, vines, chips, panelboard, starch, jack, sweetpotato glue, urea formaldehyde

1.0 Introduction

Sweetpotato is grown by poor farmers mostly women in Western Kenya (Kakamega, Bungoma, Busia) and Nyanza (Homa Bay, Rachuonyo, Kisii and Nyamira) districts. It is also grown to a small extent at the coast and central province. The crop has many uses, although it is mainly grown for its tuber, which is used in many different ways as human food, as well as feed for livestock. The leaves are eaten as a vegetable by some communities, while fresh vines are chopped into small pieces and used as concentrate feed for livestock. Tubers are also processed into flour, which is blended with wheat flour. The flour is used in the manufacture of confectionery products like cookies, bread, biscuits and cakes. Leaves are made into juice and tablets which are rich in iron. In industry, the sweetpotato has been used in the manufacture of alcohol, methane and starch. Starch from sweetpotatoes has many applications in industry. These applications include manufacture of an adhesive, which acts as a binder. The advantage of the sweetpotato binder is that it is organic, environmentally friendly, and biodegradable over time. It is also important to note that sweetpotato growing areas are not conducive for livestock because of diseases and insect pests. As such, the use of vines for livestock feeding is limited and they are usually left to rot in the field and re-cycled back into the soil. The outer portion of vines when dry is high in cellulose and lignin, which can be used in industry and add value to an otherwise, rejected material. This would in turn raise the livelihoods of farmers through extra income generation. The main beneficially would be the poor African women living in Sub-Saharan Africa.

Over 75% of wooden panels, chipboards and furniture are currently made from wood. It is a common phenomena that as a result of increase in population in Kenya which is approaching 40 million mark, land is becoming smaller and smaller. This has resulted into the dwindling of forest resources because of gradual deforestation (NEEMA, 2004). Following the high rate of deforestation and scarcity of land in general, there is a likelihood of running short of raw materials for the timber industry. It is in this regard that there is need for research into alternative sources of basic raw materials for panel and chipboard production.

Conventionally, panel and chipboards are made from wood shavings, sawdust, wood chips and fibers generated from saw mills and other wood processing factories (Tinkelenberg *et al.*, 1982). Chipboard, sometimes referred to as particleboard, is essentially an inexpensive alternative to solid wood, and is used for interior paneling projects where appearance and durability is not a priority (Michael, 2009). In Kenya, panel and chipboards are made from remains of *Cupressus sempervirens* and *Pinus resinosa*. Urea formaldehyde, urea melamine formaldehyde resin and polyisocyanate are used as binding agents (Blumer, 1991). These substances emit toxic fumes, which are harmful to the environment (Steigninger, 1990).

Panel and chipboards are made in a variety of ways. According to Steigninger (1990), they are made by compressing, applying pressure and heat of 105 to 220^{0}C to wood chips that have been mixed with a resin binder. Kakuichi (2002) reported of the procedures of making three-layered 25 x 30 cm chipboards where chips are mixed in the ratio of 1:2 with the amount of resin content sprayed from a nozzle at a pressure of 2kg/cm^2 decreased from 11% on the surface to 7% in the centre and hot pressed between 150 and 155^{0}C. The amount of residual formaldehyde is an environmental concern. In this regard, Mayerhoffer (1981) came up with a method of reducing the content of solid resin binder through uniform curing of the binder over the entire board surface resulting into improved strength. Tinkelenberg *et al*. (1882) described another method of chipboard making where lignocelluloses chips are mixed with polyisocyanate and an aminoplast resin as bonding agent are hardened at a temperature of 150-200^{0}C and a pressure of 3.5N/mm^2. In this method, cellulose is sprayed with the resin solution and spread on a suitable substrate while polyisocyanate is applied either mixed with the resin solution or separately before, during or after application of aminoplast resin.

Chipboards, although advantageous, have their own disadvantages in handling. Blumer (1991) reported that high-density chipboards are difficulty to handle and the cost of chips and glue used is high. High density result into chipboards of low moisture stability (Attwood, 1998. Conventional chipboards emit large quantities of formaldehyde into the air thus polluting the environment. According to Michael (2009), chipboards are hardy, weather proof, termite resistant, and strong. As such, waste wood material can be recycled into useful inexpensive products for the construction industry.

Currently, there is no documented report on the potential of sweet potato processing into panel and chipboard. It is against this background that this study was initiated to determine the use of sweet potato vines in the production of novel products. The main purpose of the study was to fulfill the following objectives:

evaluate industrial uses of the sweet potato vines and process some novel products such as decorative panel boards made by following the same procedures like the ones for chipboard manufacturing process.

2.0 Materials and Methods

The experiment was carried out in the laboratory and it started with the extraction of starch from the sweetpotato roots. The roots were cleaned, peeled and grated before they were ground by a blender (AACC, 2000). After grinding, the homogenate was passed through an 80 mm sieve. After which, the residue was washed three times with refrigerated water. The slurry was then passed through a 200 mm sieve and left in water overnight at 5^0C for decantation. The precipitate was recovered by centrifuging at 1700 xg for 15 minutes. The decant was washed with Ethanol, and dried at 38^0C in an air circulated oven (Peroni *et al.,* 2006). The second method of starch extraction was done by grating the peeled sweetpotato tubers, and by using an improvised presser. Starch was obtained by pouring off the slurry and the sediments were dried. Glue was made by first boiling water to 100^0C, and measuring 200mls into a jug (Hoover, 2001). After that, 200g of starch powder was weighed and mixed with the measured boiled water, to make a suspension of starch water, which was stirred into a thick paste. The paste was then poured into boiling water slowly while mixing. A thick translucent paste was obtained of was the organic adhesive.

Vines were collected from a two-year fully-grown sweetpotato crop by cutting them from the base of the mother plant. Leaves together with the petiole and tender shoots were removed. The vines were dried under shade until brittle. Dried sweet potato vines were chopped into at least 2 cm lengths by using the forage chopper. The chopped dry vines were mixed with the adhesive produced from sweetpotato very carefully in a plastic container to make sure each chip was in contact with sweetpotato glue. An improvised presser was made from metallic sheets of high density with dimensional measurement of length, breadth and height of 20 x 20 x 2 cm, respectively. The presser had two metallic sheets, one on top and the other at the bottom during pressing. First, the bottom metallic sheet was put in place. This was followed by spreading a polythene paper foil, to prevent the mixture from sticking onto the presser. The mixture was placed, first from the corners, followed by the edges, then the center. After which, another roll of the polythene paper foil was spread on the mixture, before the top metallic lid, which was followed by a wooden block as a base for the two-tone car Jack. A pivot frame was joined onto the presser circumference frame, holding the two-tone car Jack in position once it was engaged, to exert pressure onto the top of the presser so as to provide pressure. The board was left under pressure for thirty minutes, before it was removed for drying in the oven at 80^0C for 48 hours.

3.0 Results and Discussion

The resultant products are panels illustrated in Appendix 1. These panels can be used for decoration and background for picture frames. Experiments are underway to design an effective pressing machine that can produce higher pressure to make the panel stronger.

This study has shown that sweetpotato vines can produce panels. Kakuichi (2002) stressed on a single hot pressing, which progressively raises the temperature in the lower layers of the chipboard. The same technique could be used for panel boards under controlled temperature. In this study pressing was done once and the product was taken for drying in the oven. It is likely that expansion might have taken place during drying since no pressure was used in the oven. This is in agreement with Steigninger (1990) who reported that heated fibers expand during initial compression because of ductility. A second heat pressing which was not done in this study could prevent this. The findings from the study also cagree with those of Kakuichi (2002) who showed that conventional chipboards that comprise of a centre layer of coarse wood chips and sandwiching outer layers of finer wood chips are characterized by high density.

4.0 Conclusion and Recommendation

The study has indicates that sweet potato vines bound by sweet potato starch can produce panel boards. This provides an income generation activity and has potential for poverty alleviation among poor women farmers of the Sub-saharan Africa. The use of starch as a binder will minimize the emission of formaldehyde from conventional chipboards into the atmosphere.

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Appendix 1: Examples of panel boards made from sweet potato