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Development of Automatic Dry Fruit Roasting Machine

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***Abstract*— Dry fruits, groundnuts plays an important in livelihoods. Indian peanuts (more particularly the Saurashtra, Gujarat quality) are famous in the world for nutty flavour, sweet taste, crunchy texture and longer shelf life. Through generations of ideas and keeping given design restrictions in mind, the current work tried to developed a roaster which uses auto feeding system. The proposed roasting system is cheap and affordable. The proposed system may be particularly used in the roasting of goods for human nourishment such as coffee, peanuts and similar food stuffs.**

***Keywords*— Dry fruits, peanuts, drying and groundnuts**

I. INTRODUCTION

Groundnuts play an integral role in the livelihoods of the majority of the population in Africa through the provision of dietary nutrients and income. In Malawi, groundnuts are widely cultivated throughout the country, however over 70% of the production comes from central Malawi, with Smallholder farmers accounting for over 90% of the groundnut production. Groundnuts account for 25% of a household's agricultural income, which in turn accounts for 63.7% of the total income for the rural population. Groundnuts rank top on the list of alternative crops to replace tobacco, Malawi's main foreign exchange earner and are featured in the Malawi's National Export Strategy 2013-2018. Malawi is currently 9th largest exporter of groundnuts in the region, with South Africa as the largest importer of Malawian groundnuts. It has been estimated that Malawi formally exports about 15% of its total groundnut production but much more is smuggled across the borders. However, groundnuts are prone to pre- and post-harvest toxigenic fungal colonization and mycotoxin contamination. Among the currently most significant mycotoxins (aflatoxins) (AFs) ochratoxin A, patulin, fumonisins, zearalenone and some trichothecenes including deoxynivalenol), AFs are most frequently found in groundnuts and indeed aflatoxins were reported to be widespread in groundnuts across Malawi. In order to export foodstuffs to high value markets, a certain set of minimum safety standards must be met. In that respect, ways of removing of AF contaminated nuts particularly through dry blanching and manual sorting have been extensively explored and methods for achieving low levels were optimized. By following such methods, the groundnut sector has been able to gain access to markets with very stringent AF regulatory limits. However without proper aflatoxins management and control the non-compliant groundnuts may be concentrated into the local food products with detrimental consequences on public health. Therefore, the present study focuses on the fate of AFs in the groundnut value and supply chain in Malawi. The distribution of AFs in the groundnut value and supply chain was analyzed to determine the sections of the chain where AFs are concentrated. Furthermore, the public knowledge of aflatoxins was analyzed. The roaster was made out of grey cast iron (it can also come in black). It major advantage is that it is durable. For the most part, it received a fairly low rating, within a two to five star range out of five. Our team will be redesigning the existing roaster. However, the operator found several problems with the roaster. Therefore, the work aimed to correct those problems while also creating a new roaster suitable for our target customers.

The redesign altered the appearance of the former roaster. This was done externally, by incorporating an adjustable rotating blade with two of its ends, hence creating space for higher capacity rather than the fixed drum on the original roaster which had a small capacity for the beans. In the measurement and instrumentation aspect for temperature regulation, it was decided to include a resistance temperature which is used as a temperature measuring device by passing a low current through it and measuring the voltage drop. The more the temperature rises the more the resistances build up and are hence translated to degrees. First, product research was completed. Next, customer needs were analyzed and target specifications were determined. After, a concept generation morphological chart was used to develop ideas, and then limit them to the several best options for redesign. Lastly, one concept was selected via the use of a concept selection matrix. This specified design process is one which our team followed to a tee to bring forth the best possible option for redesign. It further proves that this is the best redesign selection through calculations and obtained evidence. The objective of the current work is to efficiently and effectively redesign a ground nut roaster that is automated and easy to fabricate. Through research, generation of ideas, and keeping given design restrictions in mind, our team developed a roaster i.e. a roaster and auto feeding system together. The roaster is also detachable and easy to fabricate. A morphological chart was used to generate concepts. The conceptual project 2D design is shown in the figure 1 below.

Figure 1: Automation for Dry fruit roasting machine

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II. LITERATURE SURVEY

Groundnuts especially those produced in the developing countries have been used traditionally since the origin of humanity. It is rich in oil and protein and has a high-energy value. Developing countries account for nearly 95 percent of world production. Asia accounts for about 70 percent of this amount where the major producers India and China together represent over two-thirds of global output. Other important producers are Nigeria, Senegal, Sudan and Argentina. In most of the developing countries kernels are used for oil extraction, food and as an ingredient in confectionery products. Following extraction, the residual cake is processed largely for animal feed, but is also used for human consumption. The quality attributes that are important for end users of groundnut vary among the developed and developing countries. Groundnuts are mainly processed for oil in several developing countries. Even though it is a good protein source, the cake obtained after oil extraction is not utilized to the best advantage. Production of aflatoxin due to the invasion of the fungus as per gillusflavus to groundnut pod/kernel is a serious problem in the trade of groundnuts in the international market, which has seriously hampered the export business of the developing countries. Therefore, these countries can no longer rely on monoculture in order to support their growing economies. Under current conditions, crop dependency has made producers vulnerable to losses because of the lower prices paid for the pods and kernels. It is, therefore, imperative for them to diversify their production and create added value through processing thereby reducing risks and opening new local and export markets. There is a necessity to investigate new opportunities for the use of groundnut as food and confectionery items. Most of the developing countries have poor drying and storage facilities. Under these conditions the seed loses its quality and viability in storage rapidly. The purpose of this publication is to discuss the importance of the post-production system in developing countries and to suggest suitable curing, drying, storage and processing technologies. Advised methods are especially meant for the smallholder farmers and the most diversified uses of groundnut in confectionery items. Groundnut, or peanut, is commonly called the poor man's nut. Today it is an important oilseed and food crop. This plant is native to South America and has never been found uncultivated. The botanical name for groundnut, Arachishypogaea Linn., is derived from two Greek words, Arachis meaning a legume and hypogaea meaning below ground, referring to the formation of pods in the soil. Groundnut is an upright or prostrate annual plant. It is generally distributed in the tropical, sub-tropical and warm temperate zones. Ethnological studies of the major Indian tribes of South America document the widespread culture of groundnut and provide indirect evidence for its domestication long before the Spanish Conquest. When the Spaniards returned to Europe they took groundnuts with them. Later traders were responsible for spreading the groundnut to Asia and Africa where it is now is grown between the latitudes 40°N and 40°S.

China and India together are the world's leading groundnut producers accounting for nearly 60 percent of the production and 52 percent of the crop area. India cultivates about 7.74 million hectares and produces 7.61 million tons of groundnut with the productivity level of 991.8 kg ha-1. South Africa is major producers, while in Latin America almost one half of the total groundnut produced in that region may be credited to Argentina. Among the developing countries Egypt has the highest productivity and capacity to produce groundnuts.

In most of the developing countries, the productivity levels are lower than in the United States of America, mainly due to a number of production constraints such as:

i) The cultivation of the crop on marginal lands under rained conditions;
ii) Occurrence of frequent drought stress due to vagaries of monsoon;
iii) Higher incidence of disease and pest attacks;
iv) Low input-use and
v) Factors related to socio-economic infrastructure.

The system remains more or less similar in most of the developing countries, with the exception of South Africa. Similarly in other developing countries; most of the groundnuts are used for extraction of oil for domestic consumption and export. For example, Sudan accounted for 17 percent of the world groundnut export trade. Groundnuts are important component of Nigerian diet and about 5 percent of the estimated 58.9 g of crude protein available per head per day, is contributed by groundnut. In most of the developing countries it provides high-quality cooking oil and is an important source of protein for both human and animal diet and also provides much needed foreign exchange by exporting the kernels and cake. In the literature, groundnut role as cash crop is found to completely dominate its role as subsistent food crop. In spite of groundnut importance to diets in many developing countries and the increasing emphasis on food self-sufficiency, studies on domestic groundnut consumption are especially non-existent.

III. BACKGROUND FOR CURRENT WORK

The present work is an improved processing apparatus for efficiently transferring heat from air to coffee beans to secure a uniform roasting. Accepted commercial coffee bean roasting methods have not undergone any significant recent improvements in efficiency or simplification. The principles employed in widely utilized coffee roasters are virtually the same as used over 50 years ago. One exception is that about 40 years ago a continuous rotary cylinder roasting machine was developed by the Jabez Burns & Sons, Inc. Company in the United States. The commonly utilized prior art roasters employed rotating steel cylindrical roast chambers which held the coffee bean charge occupying only about 15 percent of roast chamber volume, and which cylinder was rotated about a horizontal axis at rates of typically 60 to 90 revolutions per minute. Hot re-circulatory gases are passed about and through the cylinder, but not necessarily through the beans therein, at temperatures from 650° to 700°F., or even higher. Coffee roasting times varied from 10 to 30 minutes, and uniform roasting of each bean was not routinely achieved. Smoke, smog, organic fumes and aerosols of fine oil were abundantly liberated during roasting operations in such prior art coffee roasters. With the enactment and enforcement of air quality control standards by federal, state and municipal authorities, coffee roasting firms have become obligated to make large capital expenditures for air pollution control devices such as "after burners," the operation of which has doubled fuel consumption and operating costs.

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The movement of hot gases through the roasting beans has not been positively controlled. Some beans were always scorched (tipped) or burned due to remaining in contact with the very hot metal cylinder walls more than a few seconds. The high temperature of the gases used permitted shortened roasting times, for example, 5 minutes, with the concomitant drawback that the beans were less uniformly roasted, many beans were scorched and excessive volatiles, vegetable oils, char and degraded organics were liberated from the beans which in turn degraded coffee flavor as well as generated abundant air pollutants. Another object of the present work is to transfer heat from air into each coffee bean within a fluidized bed at a uniform and controlled rate, so that heating of each bean is uniform and equilibrated, and so that there is no excessive temperature exposure, scorching or burning of any bean or portion In view of the foregoing, a general objective of the present work is to provide an improved and simplified apparatus for batch or continuous roasting coffee beans that achieves a uniformity of bean roast not achieved by prior art methods. A closely related objective of the present work is to roast air mobilized coffee beans at a controlled low temperature which produces pyrolysis within the beans as evidenced by a darker bean cell interior than surface, and yet the roasting temperature does not liberate essential volatiles and oils from the beans thereby retaining the taste producing elements.

A further related object is to roast beans in a way and at a temperature that does not produce contaminating or polluting organic byproducts thereby enabling the roasting apparatus to remain clean and uncontaminated throughout repeated roasting cycles and further enabling the discharge of expended roasting gas into the atmosphere without introduction of undesirable air pollutants.

IV. PROPOSED SYSTEM

The proposed device refers to a new system realizing the heat gaseous flow for the roasting which principally comes to avoid the contact of the smokes coming from the heat generator with goods so excluding that polluting combustion residues come to put on the same goods. In a particular embodiment the system, re-employing the heat flow coming from the roasting, realizes and energy saving and brings to an ecological problem solution reducing the air pollution. The current system may be particularly used in the roasting of goods for human nourishment such as coffee, barley, cacao, peanuts and similar. In the current roasting plants both in those intermittent, which generally use a perforated rotating bin, and in those continuous, which use a vibrator belt, a fluidized bed or similar, the working goods are crossing by a forced heat flow, coming from the combustion chamber, consists of a mixture made of the air sucked up from outside and of the smokes produced by the heat generator. Said gas flow, at a variable temperature from 200° to 850°, comes to run over the working goods in continuous movement into the roasting chamber so to exert a licked action on the goods surface which tends to give up the suspended solid particles such as the combustion residues. This comes to determine on goods a bringing of polluting substances, such as organic substances with presence of carbon monoxide, nitrogen, sulphur and other, which come to negatively affect both on the healthy qualities of the goods and on their own characteristics so to cause damage also to their aromatic qualities. Moreover said forced flow, getting out from the roasting chamber, is taken to a variable temperature from 400° to 800° to reduce the organic substance content in suspension into it before letting out the same outside. In comparison with this current system the proposed system permits the complete problem solution using a new roasting plant which comes to avoid the contact of the combustion residues with the goods by means of a set realizing a heat induction transfer. In this way is preserved into the roasting goods both the healthy characteristic, so avoiding physical damages for the consumer, and the own characteristics so permitting the aromatic quality preservation.

The current system forces the heat and smokes production into the combustion chamber 1, by means of the burner 2, and through the collector 3 their reaching into a heat exchanger 4 with distinct flows where they make over by induction their heat to an air flow sucked from outside by an air intake 5 and then they are discharged outwardly by natural ventilation pressure or by forced intake. The flow coming from the air intake 5 so heated is let by pipe 6 into chamber 7 centrally including the combustion chamber 1. In this way said forced flow is overheated by contact with the walls of the combustion chamber 1 to the needed temperature and by means of pipe 8 is coming in roasting chamber 9 where it runs over goods in movement into the roasting unit 10. Said heat air flow crosses the goods so to heat the same to the needed temperature and then it is discharged through the pipe 11 with in suspension the roasting smokes and it is then sucked by and intake group 12 forming the forced circulation. Said gaseous flow comes finally to cyclone separator 13 having the function to take from the air flow the bigger dimension particles. The flow so cleaning through a post-combustion unit 14, able to overheat the suspended residues give out by the working goods to a higher temperature to the ignition temperature, is then turn out into the outward environment to a variable temperature from 400° to 700°. The combustion flow, which is realized in the burner 2, after to have given its heat to the flow sucked by the air intake 5 into the heat exchanger 4 can be turn outward through pipe 15. In particular system embodiment from the cyclone separator 13 the air flow, with in suspension what that still remain from the roasting, by pipe 16 comes to a collector 17, positioned at the lower end of the combustion chamber 1, which lets the same flow into the same combustion chamber so determining a further heat transfer. Moreover reaching the gaseous flow acting the heat recovery the combustion temperature, the suspended volatile substances come to burn in presence of an air over plus so going through a transformation which originates suspended no-polluting residues such as carbon dioxide, water vapor and other. Which foresees the use of a set able to heat transfer by induction and with outward expulsion of the gaseous flow from which have before been taken the roasting residues of bigger dimensions.

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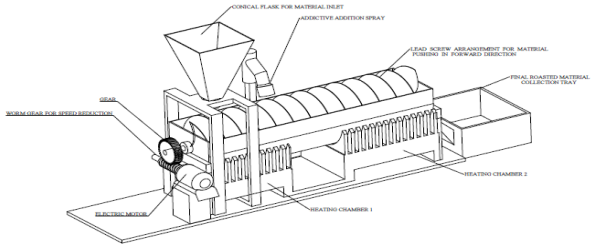

Figure 2: Diagram of the proposed system

1. The upper conical shaped show the loading direction of material inside the oven system 1.
2. Further the material is loaded inside the oven chamber1; now using the screw shaft the loaded material will be displaced in forward direction as per the speed of motor.
3. Now heating zone 1 get ready for heating.
4. Further material moves toward the addictive zone, where as per the taste requirement addictive will be sprinkled on the surface of material of taste addition.
5. Further the material moves towards the oven chamber 2, here the final roasting of material takes place.
6. The material get finally roasted & further falls inside the tray for material dispatch.

The components required to develop the current proposed drying equipment is as listed in table below.

TABLE 1: COMPONENTS OF THE PROPOSED EQUIPMENT

Sr. No	Component Name	Quantity
1.	Worm Gear box motor	01
2.	Screw conveyer blade OD 200mm Thickness 0.5 mm	04
3.	MS material square tube & flat bars	
4.	Bearing's P204 pedestrian	02
5.	Spur gear set ratio 1:4	01
6	Shaft EN8	01
7.	Select temperature controller	02
8	Heater with inbuilt blower	02

V. CONCLUSION

The final design is an attempt to make the equipment easy to use, cost effective , easy to maintain and can combine both the grinding and roasting processes in one machine. This modern design will be both affordable to most users and generate positive results. This item has been well throughout and has potential to be a popular. By using this machine quality products can be obtained with less time and as the system is cost effective it can be utilized by famers with low budget and main advantage with this system is it can be handle by the single operator it does not required skilled manpower.

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