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Design and Modification of a Yam Pounding Machine

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Abstract: ***One of the keyed driving forces that better the existence of human beings is the replacement of human energy with machine such as pounded yam machine. This is one of the ways of eliminating human effort, through the development of yam pounding machine. Yam is the oldest known recipes to man, it is a tuber crop which belong to the class of carbohydrates and has been a part of the African meal edible consumed as a meal in African countries. Yam is the common name for the species in the genius Dioscorea (family Dioscorea ceae). The primary aim of this study is to develop the frame of the machine, to develop the mixing chamber and it mechanism, to select the appropriate prime mover and testing and performance evaluation. Pounded yam is kindof food liked by more than 80% Nigerians, everyone wants to eat yam in its pounded processed form.It involves the use of mortar and paste. In conclusion, the production of the machines offer an incredible opportunity for pounding yam in large quantity within few minutes as compared to the hours that would have otherwise become wasted. The results shows2kg of yam took 3 minutes to pound, and 4kg took only 5minutes to pound. In conclusion, the pounding yam making machine made an average pounded yam meal for two matured persons in appropriate seconds after the coked yam is applied intoit.***

Keywords: Energy, Yam, Mortar, Pounding

1. Introduction

One of major tantamount desire of human beings is to search for better alternative in accomplishing a given task, most especially those tasks that are highly energetic and energy demanding in every facet of live. One of the keyed driving forces that better the existence of human beings is the replacement of human energy with machine such as pounded yam machine. This is one of the ways of eliminating human effort, through the development of yam pounding machine. Yam is the oldest known recipes to man, it is a tuber crop which belong to the class of carbohydrates and has been a part of the African meal edible consumed as a meal in African countries. Yam is the common name for the species in the genius Dioscorea (family Dioscorea ceae). The sweet potato (ipomeas batatos) has traditionally been referred to as yam in part of the United States and Canada, but it is not part of the dioscorea ceae family.

The word yam came from portugues name or Spanish name which both ultimately derive form the wolofwordnjom, meaning “to sample” or taste”. In other Africa languages it can also mean “to eat” e.g yam and nyama in Hausa (Miguouna et al, 2003). They are perennial herbaceous vines cultivate for the consumption of their starchy tubers in Africa, Asia, Latin American and Oceania. They are used in a fashion similar to potatoes and sweet potatoes, (Bransmilleretal, 2003). There are over Nigeria, and each has different language in wage name for yam “Isu” is the Yoruba translation or “Iyam” when it is been prepared to be consumed as main source for dinner. The yam is a versatile tuber crop which has various derivation products after processed into a dessert recipe. Yam is the staple crop of the Igbo people of Nigeria, in their language it is known as “Iji” yam is commemorated by having Iri-ji or Iwa festival in the southern Nigeria and new yam festival in the south western part of the country.

Pounded yam is kind of food liked by more than 80% Nigerians, everyone want to eat yam in its pounded processed form. However, due to much energy in healthy state required in getting the require texture, makes it difficult for most people to get it discarded as part of their meal menu in some family and this has limited the consumption rate of pounding the yam. It involves the use of mortar and paste.

The method is time consuming and energy consumed causing desire of many to be water low from making it their favorite.

The primary aim of this study is to design and modify an existing yam pounding machine, the objectives are to modify a yam pounding machine using some locally available materials and affordable to even those at the remote areas.

They ampounding machine plays vital role as it helps in replacing drudged or stress initiated into human system after pounding has taken place, the machine will also help to the physically disable individuals as well as the aged to pound yam, since less effort will be required in its operation. Another significant role this research plays is that, it will make ways for further research to the design and fabrication of yam pounding machine.

This work is limited to the design and modification of an existing yam pounding machine for domestic use.

2. Methodology

2.1 Mode of Operation

The main control system of the machine is the electric motor. The electric motor generates a toque that is transmitted via the v-belt to from the driver pulling to the driver pulley. The torque generated by the driven pulley

transmits a rotational motion to the transfer to the beater. The dual beaters function on the principle of rotational motion absolute reduction of the lumps of the cooked dioscoreas' family into a micro size smooth to touch by bear hand. The driver pulley also irtrate the bevel gear system into rotational action permode of operation. The bevel pulley transmitter to queto the bevel teeth so as to engage the system for the purpose of rotating the drum or the beater chamber for evenly distribution of beating force with respects to lamps reduction. Below is the flow chart diagram of yam pounding.

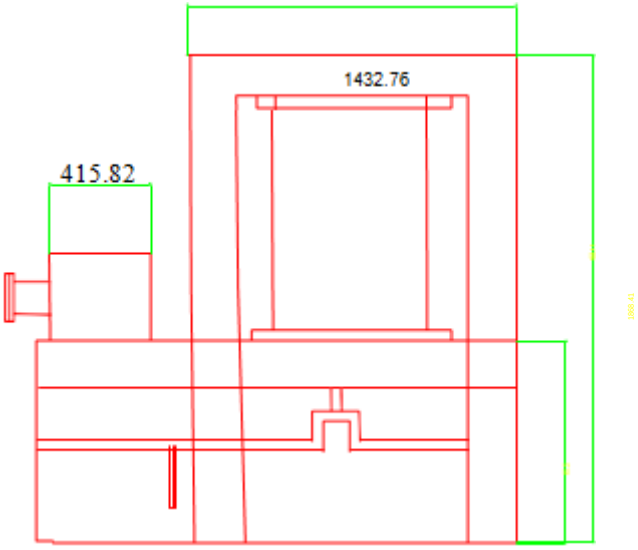

Figure 1(A): Yam Pounding Machine

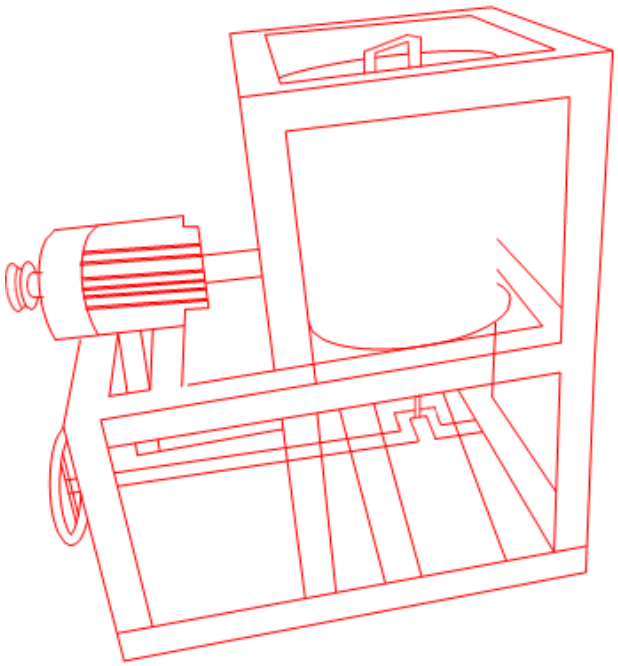

Figure 1(B): Yam Pounding Machine

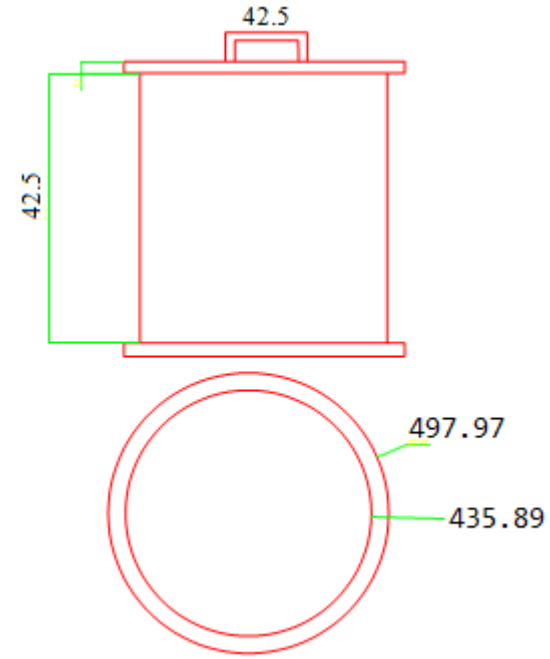

Figure 2: Pounding Bowl

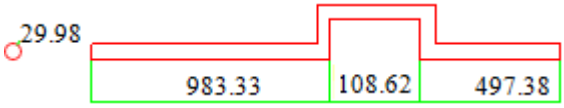

Figure 3: Shaft

3. Development of Mixing Chamber and its Mechanism

This is the determinant of the effectiveness of the machine speed we selected –mm for the driving pulley on the electric motor side and to achieve speed required for hp electric motor of orpm, the required speed was 720 rpm using the ratio. Using standard equation, we can determine the diameter of the driven pulley as follows;

$$d_1 N_1 = d_2 N_2 \quad (1)$$

Where d_1 is the diameter of the puller and equals 30mm, d_2 is the unknown diameter of the driven pulley.

$$d_2 = \frac{30x1440}{720} = 60mm$$

Peripheral velocity in ms^1

$$\tau = \frac{peripherelvelocityinm5}{\frac{\pi}{2}(d1+d2)+2\pi+\frac{1}{4\pi}(d1+d2)2}$$

Where
π= center distance by measurement
Implementing the equation below

$$\sin\Theta = \frac{d2-d1}{2\pi}$$

$X = 27^0$

$\Theta_1 = 180^0 - 2x = 174.6^0$

$$= 174.6x\frac{\pi}{180} 3.05 \text{ rad}$$

$\Theta_2\ 180^0 - 2x = 185.4^0$

In radian

$=185.4 \times \frac{\pi}{180} 3.24 \text{ rad}$

Since both pulleys chosen are of the same material the selected coefficient of friction will be the same and the equal 0.35 (Gupta, 2009).

2.3 Belt Tension

$$\frac{T^1}{T_2} = e^{f\theta} \quad (5)$$

Θ = contact angle
T= Tension
No1 = 0.35x3.05=0.915
No2 = 0.35x3.87 = 1.134
T1 = tension on tight side
T2 = tension on the slack side
Using on electrical motor which has maximum power of 746W
P = $(T_1 - T_2)$

T1 – T2 = 336.7N….. (1)

Therefore, using the standard equation we selected NΘ2 so having higher effect.

2.3 log $(T_1/_T)$

This implies that

T1 = 560.62N
T2 = 224.34N

2.4 Blade Design

L = length = 275mm
W = width = 20mm
T = thickness =4mm
Volume = length x width x thickness
V = L x W x T
V = 275 x 20 x 4 = 2200mm^3
P = density of stainless steel = 7500kg/m^3
M = mass = density (p) x volume (v)
M = 7500 x 0.00022 = 0.165kg
Weight = mass x acceleration due to gravity (9.8m/s^2)
W = mxg
W = 0.165 x 9.81 = 5.294N

2.5 Selecting the Appropriate Prime Mover

Using 1 horse power (HP) electric motor standard speed = 1400rpm, maximum speed of the machine used to find the maximum torque.

$$T = \frac{P \times 60}{2\pi N} \quad (6)$$

P = power in watt. N= speed in revolution per minute
1ph = 760 watt
T= 5.18Nm

4. Results

The constructed yam pounding machine was tested by pounding white yam. The yam was washes, peeled, cut into small pieces and cooked for same period. The cooked tuber yam were then loaded into the pounding bowl of the machine. The machine was then operated to pound the cooked discorea family yam for a particular period of time.

Water was added to the pounding yam inside the pounding chamber for the purpose of achieving clump less and smooth texture

Table 1: Pounding results

S/N	Pounding time	Mass (kg)
1.	3	2kg
2.	5	4kg
3.	7	6kg

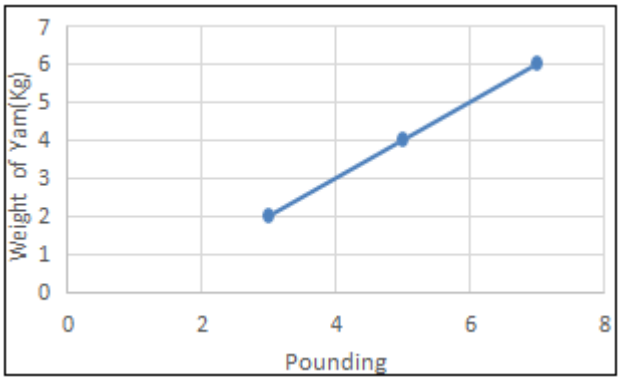

Figure 5: Variation of Time in Pounding the Yam

5. Discussion

The most edible consumed food in West Africa, most especially in Nigeria is pounded yam. The indigenous process of pounding pounded yam is very stressful. During the locally pounding exercise two or three agile and able person are subjected into executing the pounding in a wooden motor for same stipulated time of texture fines. The production of the machines offers an incredible opportunity for pounding yam making in large quantity in few minutes as compared to the hours that would have otherwise become wasted. From the graph above, it took 3 minutes to pound 2kg of yam, and 5 minutes to pound 4kg of yam. In conclusion, the pounding yam making machine made an average pounded yam meal for two matured persons in appropriate minutes after the cooked yam is applied into it.

6. Recommendation

The major confrontation encountered was the unavailability of appropriate material for design and fabrication of the machine due to high cost of material in the market. It was also discovered the machine pound the yam in blending manner, despite the fact that we were able to get the end of result, we further recommended that next level of research should be done by pounding the yam vertically.

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