

CONSTRUCTION AND PERFORMANCE EVALUATION OF A MANUAL GROUNDNUT SEED DRUM ROASTER FOR FARMERS IN NORTHERN NIGERIA

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Abstract

The wide range usage of groundnut and its products has led to increase in its demand. However, the local methods of roasting Groundnut seeds after it has been shelled has some associated problems and difficulties which makes it ineffective laborious, and time consuming. The traditional methods of roasting are time and energy consuming. A Prototype manual operated Groundnut seed Drum Roaster was designed and constructed with the aim of improving on the traditional methods commonly used in the Northern Nigeria. The prototype shows the roasting efficiency (Er) to be in the realm of 98.9% with percentages of seed damaged (loss) in the range of 1.1-2.0%. The Groundnut seed roasting machine throughput capacity was estimated to be in the range of 33-36kg/h using SAMNUT-10 (RMP-9) variety of groundnut seeds. The minimum time for roasting was estimated to be in the range of 2.5 – 3.0 minutes. It was therefore recommended that for optimum roasting the groundnut should be sun dried before roasting.

Introduction

Among the agricultural products that are great value to both man and animals is the groundnut. It serves as raw material for industry. Groundnut oil is also as vegetable oil for human consumption, while groundnut seed cake is being used as part of ingredients in animal and poultry feeds (Burkul, 1985; Pattee, et al, 1995). The wide range of usage of this agricultural product has led to increase in its demand. Among the problems in processing agricultural materials is that of roasting the seeds.

Pattee, H.E. Giebrecht, F.G and Isleib, T.G, (1995); Maria, C.A., Trugo, L.C., Aquino Neto, F.R; Moreira, R.F.A and Aiviano, C.S., (1996); and Olapade and Akinoso, (2004), defined roasting as the process of generating characteristic aroma, flavor and colour required by consumers for acceptance of such roasted food. Roasting of food bring about thermal changes in the chemical components at relatively high temperature. This is accomplished by either using a hot air or small metal surface to heat up the material to the required temperature at which the material changes to required colour and according to Gell and Porto (1996) must be abruptly stopped using cool air to avoid food destruction. However, Roasting operation is traditionally done using different pots such as clay pots, aluminum pot, etc, on an open fire until they are brown (Ihekonye and Ngoddy, 1985). This method is ineffective, time consuming and laborious and subject people to back pain and expose them to smokes and heat from fire apart from firewood wastage Oguntunde (1987) suggested the use of infrared heating in roasting operations to improve on the traditional techniques. This involves designing and constructing of a machine that will handle this operation more effectively than the traditional methods. The machine after construction will enhance increase in groundnut oil/cake production, which will serve as raw material for relevant cottage industries in Nigeria. The machine is also designed to eliminate the drudgery associated with the traditional method of roasting groundnut.

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In Nigeria mechanical roasting machines such as Cashew roaster, Cowpea, Cake and peanut roaster are available but the high cost and inaccessibility to most people makes traditional roasting the common practice. Traditionally roasting is done using different pots such as clay pots, aluminum pot, etc on an open fire until they are known (Ihekonye and Ngoddy, 1985).

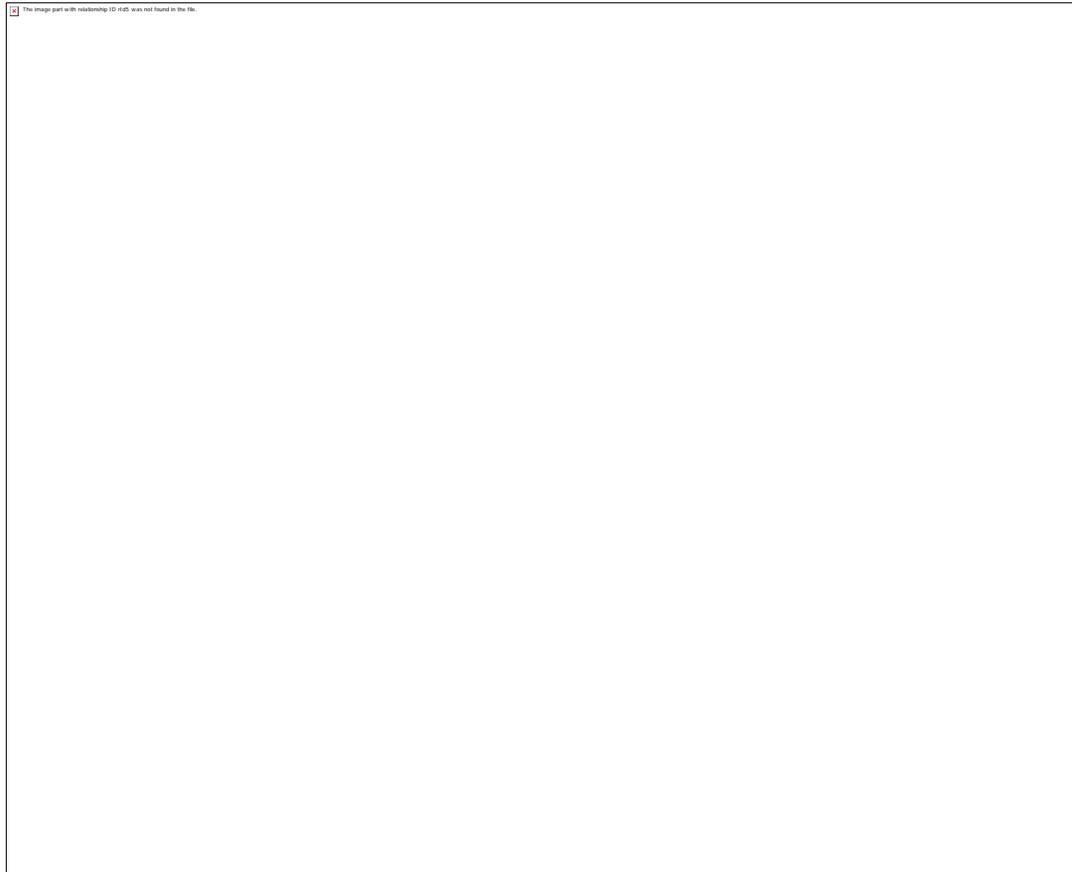
Materials and Method

Selection of materials used in construction of the Drum Roaster placed emphasis on some criteria like cost, durability, strength, availability, size and weight of such materials.

Description of the Drum Roaster

The various components of the manually operated, low cost, groundnut used drum roaster is as shown in fig 1 and 2. The Roaster machine comprises of five major parts the frame, the stirring paddle, the roasting chambers, the heating source and the fan. The Frame is fabricated from (30x30mm) angle iron. The frame is welded to shape as shown in fig. 1. It provides support to the entire components of the roaster. The stirring shaft comprises of the driving shaft and stirring paddles. The driving shaft is made up of a mild steel rod and the stirring paddles welded directly on the driving shaft as shown in fig 1. As the operator cranks the handle, the stirring shaft and its accessory rotate thereby setting up a centrifugal force in the roasting chamber and this turns the seeds in the chamber.

The Roasting chamber comprises of the drum and some outlets. The roasting drum has two outlets (i.e. the inlet and the seed outlets). The heating chamber is positioned directly under the roasting drum as shown in fig 2. It is the source of heat to the roaster. It is fabricated from galvanized sheet. It has a blower positioned by the side to supply air that allows the charcoal to burn continuously. The blower gives uniform amount of heat to the entire drum. The optimum speed of operation is estimated to be 30 – 40 rpm



Performance Evaluation

The parameters used in evaluating the groundnut seed drum roaster are the roasting efficiency (Er)% and Man-Hour per kilogramme of seeds roasting, (Mh). Also the mathematical evaluation expressions for roasting efficiency were used as stated in equation (1) and (2).

Construction and Performance Evaluation of a Manual Groundnut Seed Drum Roaster for Farmers in Northern Nigeria

$$\text{Roasting efficiency (Er)\%} = (W_r/W_t) \times 100 \dots\dots\dots(1)$$

$$\text{The percentage of seed losses (EI)} = (W_d/W_t) \times 100 \dots\dots\dots(2)$$

Where: W_d = weight of roasted seed damaged (over roasted)
 W_r = weight of roasted seed not damaged
 W_t = total weight of seed roasted ($W_t + W_d$)

The man –hour –kilogram (Mh)

Table 1 shows the comparative analyses results and it involves comparing the output of the various manual methods of roasting with that of the prototype roaster.

This comparative analysis has to do with efficient utility of time by the various methods. Hence, the throughput capacity (Qt) and Man-hour per kilograms for roasting seeds by the three (3) different methods are analyzed and displayed in table 1. Other performance parameters like roasting efficiency and percentage of seed damage are also displayed in Table 2.

Result and Discussion

Table 1 shows the comprehensive performance of the groundnut seed roaster. The evaluation parameters used are the roasting efficiency (Er), throughput capacity (Qt), effective time (Te) and percentage losses of seeds. The roaster efficiency appears to be generally high in the range of 97.8 to 98.9% at five different level of roasting groundnut seeds in the drum roaster. Seed losses (EI), was observed but at a low level in the range of 1.1 to 2.2%. In addition, the throughput capacity (Qt) of the roaster was evaluated to be in the range of 33 to 35 kg/h as shown in Table 2.

One of the distinguishing features of the roaster is that instead of using firewood as the source of energy, wood Charcoal was used to supply heat the roaster.

Table 1. Performance Evaluation Parameters of the Groundnut Seed Drum Roaster

| S/N | Weight of G/nut seed Wt (kg) | Weight of Roasted seed Wr (kg) | Weight of seeds damaged Wd (kg) | Time T(min) | Roasting efficiency (Er)% | Loss (EI)% | Throughput capacity Qt (kg/h) |
|-----|------------------------------|--------------------------------|---------------------------------|-------------|---------------------------|------------|-------------------------------|
| 1 | 0.46 | 0.44 | 0.01 | 0.82 | 97.8 | 2.2 | 33.66 |
| 2 | 1.39 | 1.34 | 0.03 | 2.5 | 97.8 | 2.2 | 33.36 |
| 3 | 2.78 | 2.14 | 0.04 | 4.9 | 98.6 | 1.4 | 34.04 |
| 4 | 5.50 | 5.42 | 0.06 | 9.5 | 98.9 | 1.1 | 34.02 |

Where

W_t – weight of groundnut seed before roasting
 W_d – weight of seeds over roasted (damaged)
 W_r - weight of roasted seeds (unbroken and broken) that are not damaged
 T_s – time taken to roast the groundnut seeds.

Conclusion

The groundnut seed roaster constructed during this investigation was observed to roast groundnut seeds at faster rate than any other manual methods as shown in Table 1. Although, there is the need for sun drying of the seeds before roasting.

The drying required was observed to be lighter, because the moisture content required at shelling is almost the moisture content require for roasting. Also the roaster was observed not to have any negative effect on the market value of the roasted seeds.

Recommendations

It is recommended that for optimum roasting the groundnut should be sun dried before roasting.

Further investigation on groundnut seed varieties should be carried out at various roasting moisture content to determine the optimum moisture level that would be convenient for roasting.

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