время носок наральника 4 стойки 3 пройдет по дуге $B - B$, следовательно стойка 3 повернется на оси 6 без подъема всего глубокорыхлителя, что приводит к повышению надежности стойки 3 и установленных на ней боковых ножей 5 и Г-образных боковых ножей 11.

**Заключение.** Применение предлагаемого многофункционального глубокорыхлителя позволит производить качественное разделенное или одновременное рыхление подпахотного и пахотного слоев почвы, что расширит его функциональные возможности и обеспечит надежную защиту стоек во время преодоления препятствий.

## Список использованной литературы

1. Лепешкин, Н.Д. К обоснованию типа рыхлительных рабочих органов почвообрабатывающего агрегата для влагонакопления и влагозадержания на склоновых землях / Н.Д. Лепёшкин, В.В. Мижурин // Механизация и электрификация сельского хозяйства: межвед. темат. сб. / РУП «НПЦ НАН Беларуси по механизации сельского хозяйства». – Минск, 2022, Вып. 55 – С. 138 – 147.

2. Глубокорыхлитель: пат. 12817 Респ. Беларусь, МПК A01B 13/00 / Н.Д. Лепешкин, В.В. Мижурин; заявитель РУП «НПЦ НАН Беларуси по механизации сельского хозяйства» – № u 20210214; заявл. 16.08.2021; опубл. 15.12.2021 – 4 с.

UDK 631.

# DESIGN AND FABRICATION OF PEANUT THRESHING MACHINE

# РАЗРАБОТКА И ИЗГОТОВЛЕНИЕ МОЛОТИЛЬНОЙ МАШИНЫ ДЛЯ АРАХИСА

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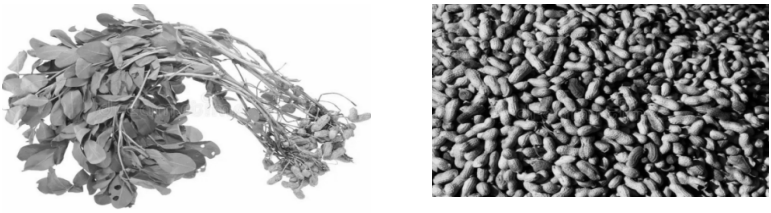
*Аннотация*: Машина предназначена для отделения орехов от стручек арахиса с помощью цилиндрического барабана с плоскими железными венчиками для разрушения стручка арахиса. Машина состоит из молотильной камеры и генератора (2 л.с.), которые соединены между собой клиновым ремнем стандарта B-55 с шагом 1450 мм. В качестве материала для молотильного барабана используется мягкая сталь. Все материалы, используемые в производстве, поставляются на месте, чтобы обеспечить доступность и простоту обслуживания для мелких фермеров. Машина была протестирована с использованием различных сортов арахиса, найденных в Северной Нигерии, и результаты были сравнены с данными обычных ручных машин. Результаты показывали, что разработанная машина работает быстрее и эффективнее. Эффективность обмолота составляла 84 % для сорта «SAMNUT 24» арахиса сухости 85 %.

*Abstract*: The machine is design to separate the nuts from its pod by using a cylindrical drum with flat iron beaters in order to break the peanut pod. The machine is made up of threshing chamber, and a generator (2 HP) that are arranged and connected by a B-55 standard v-belt with a pitch length of 1450 mm. A mild steel is used as material for the threshing drum. All materials used in the fabrication are sourced locally to maintain affordability and easy maintenance by smallholder farmers. The machine was tested using different varieties of peanut found in Northern Nigeria and compared the results with the manual conventional ones. Results shows that the constructed machine performed faster and more effectively. The threshing efficiency is 84% for peanut of 85% dryness.
*Ключевые слова*: Арахис, стручок, молотилка, изготовление, конструкция.
*Keywords*: Peanut, pod, threshing machine, fabrication, design

**Introduction.** Peanut or groundnut is a legume plant species belonging to 'bean' family. It grows in the Northern part of Nigeria in states like Kano, Kaduna, Adamawa, Borno, Taraba, Sokoto and Bauchi among others as it tends to do well in the arid or semi-arid regions [1]. Peanut farming is one of the lucrative agricultural businesses due to its demand for nutritious seed and cooking oil derived the seeds. After harvesting peanut can be threshed for further processing depending on the product one wants to derive from it. The threshed pods can be boiled, fried, roasted, or eaten raw with other meals.

Peanut farming in Nigeria serves as a means of livelihood for small-scale farmers, most especially in the Northern part of Nigeria. Nigeria is the third largest producer of peanuts in the world as shown in Table 1 below [2]. Nigerian peanuts are available in early-maturing varieties suitable for short rainfall regions and late-maturing varieties suitable for areas with prolonged rainfall.



*a* *b*

Figure 1 – Peanut legume (*a*) and pod (*b*)

Peanuts are important protein crops in Nigeria grown mostly under rain-fed conditions. It is one of the most essential raw materials in Nigeria because of the high demand for its product and by-products. Peanut pods (Fig. 1b) after harvesting can be sold to individuals and processing factories depending on what it wants to be used for.

Sources: [2]

Several threshing machines were developed by different scientist and fabricators, such as hand-operated peanut sheller, rubber-powered groundnut sheller among others [3], [4] and [5]. These machines were expensive for smallholder farmers and producers to import and require maintenance which sometimes involved replacement of spare parts which are not readily available in the local content. However, [6] designed and fabricated a similar machine with local materials which an efficiency of 78 % while it used spike to shell the pods.

Table 1 – Peanut production in different countries

| S/N | Country | Production (million tonnes) |
|---|---|---|
| 1. | China | 17 |
| 2. | India | 9.5 |
| 3. | Nigeria | 3.0 |
| 4. | United States | 1.9 |
| 5. | Myanmar | 1.4 |

The purpose of this research is aimed at using drum with flat iron beaters in the threshing of the peanut pod to replace the existing design and improve on the threshing capacity with local low-cost available material.

**MATERIALS AND METHODS.** Materials. The materials used were locally obtained from *Kara* market and Aliyu Jodi road, all within Sokoto metropolis of Sokoto State in Nigeria. The selection of these materials was made based on their physical properties such as durability, cost and availability, strength and rigidity.

Description of the Peanut Threshing Machine. The main components that were assembled to form the fabrication were: the frame, hopper, auger shaft, seed discharge outlet, threshing chamber, blower and chaff outlet.

Frame. It is the main support member for the machine and must be able to hold and withstand various stresses and loads as well as maintaining good welding properties. However, it holds the hopper, the rotating shaft, threshing chamber, as well as the prime mover and source of power (electric motor). Hitherto, a suitable mild steel in the form of angle bar was used.

Hopper. It contains the raw unthreshed peanut before and during the threshing operation. It is made up from mild steel sheet of 2 mm thickness. The hopper must be able to be of good strength and resistance to corrosion as well to withstand the vibration loads and stresses.

Threshing Chamber. It houses the shaft and the threshing drum. The threshing operation occurred inside it. Therefore, it must be able to withstand load and stresses, good weld ability and corrosion resistance. The diameter of the threshing drum is 250 mm with flat iron bars beaters around the cylindrical circumference. The active length of the drum is 470 mm. So, mild steel of 2 mm thickness was selected.

Seed and Chaff Discharge Outlet. The threshed peanut seed is collected through this outlet. The seeds fall under gravity from the threshing chamber on a level ground spread with tarpaulin or similar collection material. It must be good strength and have high resistance to impact loads. Therefore, mild steel of 2 mm thickness was used. The broken/crushed pod is separated from the peanut by pressure provided from the fan which is also made from mild steel of 2 mm thickness.

Fabrication Process. The fabrication was executed at metal workshop at the Department of Technical Education, Shehu Shagari College of Education, Sokoto, Sokoto State, Nigeria. After thorough understanding of the design involved in the research, The fabrication process involved purchase of required materials. However, several operations which include marking out and cutting of components, bending and folding of sheet metals, welding, drilling, debruising by grinding, assembling, body filling and painting were done.

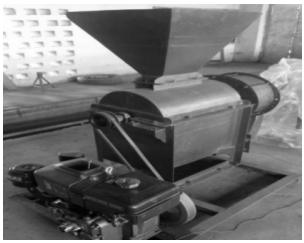


Figure 2 – Peanut threshing machine

Operation of the threshing machine. The dried nuts were fed into the machine through the hopper. The power source (diesel generator) is connected to the threshing chamber with the aid of pulley. As it supplies the power, drum rotates and breaks the pods by beating against the lower concave stationary sieve of the chamber wall. The air produced by the action of the fan (or blower) sweeps the both seeds and thresh fragment out of the threshing zone into the inclined outlet unit. As there is no separation chamber, the collected products are then taken for winnowing or separation. The fabricated machine is shown in Figure 2 after assembling and painting.

**RESULTS AND DISCUSSION. Performance Evaluation.** The test was carried out with a 2 horse power (1440 rpm) diesel generator using peanut nuts of various quantities. The unthreshed peanut were bought from Sokoto Central Market dried. Then, the machine was fed with a constant mass of 30kg of peanut pods. After threshing, upon threshing, the quantity of pods threshed and unthreshed were collected and weighed separately. The efficiency obtained was shown in Table 2 and 3 below [7].

Table 2 – Result of threshing efficiency

| Test | Total weight (kg) | Threshed (kg) | Broken (kg) | Unthreshed (kg) | % Threshed | % Broken |
|---|---|---|---|---|---|---|
| I | 30 | 24.9 | 4.0 | 1.1 | 83 | 13 |
| II | 30 | 25.1 | 4.4 | 0.5 | 84 | 15 |

By using the fabricated peanut threshing machine, we can save more money and faster work when compared to conventional manual machine. And also, labour is very expensive now-a-days and the manual process require many people to achieve required tonnage per day. Therefore, it will help the farmers and peanut processors to thresh with minimum time and money as well to cover the required tonnage in a shorter time. Based on the working of the peanut thresher the following performance analysis were obtained as shown in Table 3 below.

**CONCLUSION AND RECOMMENDATIONS.** The peanut threshing machine was fabricated calculated design parameters. Locally and easily available materials were used for the fabrication. The machine was run with different varieties of peanut found within the locality and threshing efficiency was obtained. The efficiency of the machine was about 84 % for peanut of 85 % dryness. Based on the results of the study, recommendations were suggested as follows:

– Research and development centres/institutions where technological equipment design and fabrication are carried out should be empowered by providing them with research grants;

– Federal government should place a ban on importation of equipment that can be efficiently produced in the country;

– Where necessary, an expatriate(s) can be employed by the government to lead in design and fabrication of complex machines and members of engineering departments of higher institutions in Nigeria should be availed the opportunity to learn from these expatriates;

– The staff in Research and Development units should be adequately remunerated as a means of motivation in order to make the job very competitive.

– Table 3 –Result of average threshing efficiency

| | Average threshed | Average broken |
|---|---|---|
| % by mass | 84 | 14 |

– Table 3 - Performance analysis of the threshing machine

| S/N | Description | Values |
|---|---|---|
| 1. | Number of workers required (Nos) | 1 |
| 2. | Collection of threshed peanuts per hour, kg | 180 |
| 3. | Total working time period/day, hours | 8 |
| 4. | Collection of peanuts per day, kg | 1,440 |
| 5. | Cost per labour, Naira | 3,000 |
| 6. | Fuel required, ltrs/hr | 4.2 |
| 7. | Total fuel required, ltrs | 33.6 |
| 8. | Cost of fuel with oil, Naira | 13,940 |
| 9. | Total fuel cost, Naira | 13,440 |

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## References

1. Maduako, J.N., Saidu, RA, Matthias, P. and Vanke, I. (2006). Testing of an Engine Powered Groundnut Shelling Machine. Journal of Agricultural Engineering and Technology, vol. 14, pp.

2. Rajnish, R Dubey, Ravi M, Nandhu T, Nithin S A, Vijai R. (2019). Design and Fabrication of Groundnut Thresher Machine. JETIR, vol. 6 (5). www.jetir.org.

3. Akerele, O. V. and Ejiko, S.O. (2015). Design and Construction of Oil Expeller. International Journal of Engineering and Computer Science, India, ISSN 2319-7242 Vol. 4, Issue 6, pp. 12529–12538.

4. Okegbile, O.J, Hassan, A.B, Mohammed, A and Obajulu, O. (2014). Design of a combined Groundnut Roaster and Oil Expeller Machine. International journal of science and Engineering Investigations, vol. 3, issue 26, pp 26–30.

5. Okegbile, O.J, Hassan, A.B, Mohammed, A and Obajulu, O. (2014). Design of a combined Groundnut Roaster and Oil Expeller Machine. International journal of science and Engineering Investigations, vol. 3, issue 26, pp 26–30.

6. Khurmi, R.S. and Gupta J.K. (2005). A Textbook of Machine Design. Multicolour illustrative ed., Eurasia publishing house (PVT) Ltd. by S. Chand & Co. Ltd, India.

7. Azeez, T.M. et al. (2017) Performance Evaluation of a Developed Maize Sheller, J. of Advancement in Engineering and Technology, V5I2. DOI: 10.15297/JAET.V5I2.04.