

CONSTRUCTION AND TESTING OF CHARCOAL MINI BREAD BAKING SYSTEM FOR DOMESTIC SMALL BUSINESSES

Musa Umar¹, Tukur Alkali², Bawale Ibrahim³

Department of Mechanical Engineering, Umaru Ali Shinkafi Polytechnic Sokoto
1 mubazz2000@gmail.com, 2 tukuralkali@yahoo.com.

ABSTRACT

The domestic bread baking system is an equipment and process designed for baking bread at home. The project aims to design and construct a domestic bread-baking system for economic enhancement. The project's objectives are to design and construct a domestic bread-baking system that is portable, efficient, and cheaper than the modern means of baking. The scope of the study will cover the design and construction of a domestic bread-baking machine that can bake ten medium-sized and five large-sized breads. The domestic bread-baking system was successfully constructed and tested after the construction. The domestic bread-baking system was put to the test to determine its functionality and effectiveness through some food items like bread. Both ten or five slots of bread could be baked in thirty minutes when the temperature of the ovum reached 70°C per cycle, but for the ten pieces and five pieces of the bread, it was at 50g and 100g, respectively. After the domestic baking system had been tested, it was realized that it was economical, efficient, and faster. It was recommended that there should have been a temperature control system, thermostat, ventilation system, control panel, and sensor.

Keywords: Bread, Baking, Domestic, Small Business

INTRODUCTION

Using dry heat, baking is a food preparation technique carried out on hot stones, in hot ashes, or an oven. While bread is the most frequently baked food, baking is possible for various foods. With a bread-baking system, heat is progressively moved from the outside to the interior of cakes, cookies, and bread pieces. Doughs and batters become baked items as heat moves through them. Baking has historically been done for local consumption at bakeries and restaurants and home for daily meals (Viegas, 2009). Machines in ample facilities automated baking as production became more industrialized. Baking is still an essential skill and is nutritionally significant. Also benefit from wood-fired system. (Numanovich & Abbosxonovich, 2020)

Home baking is baking bread, cakes, cookies, and pastries in a home kitchen instead of a commercial bakery. Bread baking is a versatile process with countless variations in ingredients, techniques, and types of bread produced, ranging from simple sandwich loaves to artisanal sourdough pieces. Although professional-grade equipment is not necessary for home baking, specific tools are commonly used to facilitate baking.

It would help to combine flour, salt, yeast (or another leavening agent), and water to produce bread. After that, the dough is shaped, raised, and cooked. Baking bread, cakes, cookies, and pastries in one's kitchen instead of a commercial bakery is known as "domestic bread baking." Depending on the ingredients and techniques employed, bread baking is a versatile process that produces a wide range of breads, from artisanal sourdough breads to



simple sandwich loaves. While expensive equipment is unnecessary to bake at home, some simple tools make the process go more smoothly. Baking bread, cakes, cookies, and pastries in a home kitchen instead of a bakery owned by a business is known as

Over time, this bread-making system can reduce costs compared to regularly purchasing bread from the grocery store. Generally speaking, baking bread at home requires fewer ingredients than purchasing it from a store, which may prove more economical in the long run. Those who make bread at home with a bread-making machine can avoid preservatives, additives, and other undesired components that are sometimes included in commercial bread products since they have complete control over their ingredients. This could lead to better eating habits and more control over dietary preferences and restrictions. Moreover, nothing compares to the aroma and taste of freshly baked bread. A bread-baking method at home guarantees the best freshness and

This project aims to design a bread-baking system for home use with the best performance, the most minor maintenance, and the most affordable cost possible using engineering techniques and materials. Furthermore, the bread-baking mechanism will be designed to minimize the heat and smoke people are exposed to.

Statement of the problem

The removal of fuel subsidies has become a catalyst to an already economic challenge. The class of B40 is facing the most difficulties in the history of Nigeria. The masses are searching all avenues to survive. The essential commodities every day are escalating, and we are not talking about shelter or clothing but the severe issue of hunger. People are searching for innovations in food to make life easy. The use of petrol is constantly rising, cooking gas is becoming another challenge, and there is no constant electricity supply. Rice is becoming difficult for the masses, and the price of Guinea corn, maize, and beans is not affordable. The Bread Baking Association is having meetings over meetings. To look for the subsidy of at least one baking food, test baking bread, not only the flour, such as maize, or formulate other types using any easy-reach food stock. This is why there is a need for a small mini-baking system rather than looking for a high investment to start a baking house to test the mentioned alternative.

Aim

This project aims to construct a bread-baking system for a family so that the family can prepare bread with the required taste and economic value. At the same time, the system can generate income as a source of small business.

Objectives

1. To construct the system in a portable and affordable form.
2. Use a green source of heat energy and be environmentally friendly.

Scope of the baking system

The baking system can accommodate ten small-sized baking pans at once, but the large baking pan can only accommodate five. Depending on the efficiency achieved in generating

the required heat within a shorter period, many turns can be performed. Two turns will give twenty or ten slots of bread.

LITERATURE REVIEW

A clay or ceramic bread baking system is a traditional wood-fired oven to prepare bread and other baked items. Often made of clay or other heat-resistant materials, these ovens yield delicious, crusty bread with a soft, chewy interior. They aim to hold on to heat and disperse it evenly around the baking chamber. One of the unique qualities of a ceramic bread oven is its ability to produce high temperatures. Baking bread with the perfect crust and crumb is required. A clay or ceramic bread baking system is a traditional wood-fired oven to prepare bread and other baked items. These ovens yield delicious, crunchy bread with a chewy, soft interior and are typically made of clay or ceramic.

When utilizing a ceramic bread oven, the oven must first be heated by burning wood until the interior reaches the proper temperature. When the oven reaches a high enough temperature, the wood is removed, and the bread or baking stones are placed directly onto the oven floor. The powerful, radiating heat from the floor and walls of the oven bake the bread to perfection, resulting in a juicy, soft interior and a gorgeously golden crust. Traditional bakeries are familiar places to find ceramic bread ovens, which are highly prized for their capacity to provide excellent baked foods. (Dering, 2019).

Monitoring the temperature and properties of the wood used as fuel while using a ceramic bread oven is crucial. Achieving consistent, high-quality outcomes in the oven requires knowledge of controlling the heat and airflow. Different types of wood can add distinct flavors to the bread. A ceramic bread oven is an example of a traditional, age-old baking technique still valued for the beautiful bread and baked items it creates. The art and science of using a ceramic bread oven give a unique touch to the baking process and provide extraordinary results, whether in a home kitchen or a commercial bakery. (Forno, 2015). See plate one below.



PLATE 1 CLAY/CERAMIC BREAD BAKING SYSTEM

A gas-bread baking system is a contemporary and effective way to use gas-powered ovens and baking supplies to make bread and other baked items. Large-scale manufacturing facilities, commercial bakeries, and even some smaller bakeries that favor the control and convenience of gas-powered baking equipment employ this technology extensively.

Gas bread baking systems are engineered to deliver accurate temperature regulation, rapid heating, and uniform heat dispersion. Their dependability, quick heating times, and affordability make them famous. Furthermore, gas ovens frequently have sophisticated controls and programmable settings that enable bakers to alter baking cycles and produce reliable outcomes for many bread varieties (Bizzaco, 2021).

Various baking-specific equipment is usually included in the gas bread baking system. This could include gas-powered rack ovens, convection ovens, and deck ovens. These ovens provide a range of baking possibilities, from specialty bread products to artisan loaves, and are built to hold enormous quantities of bread. (Bizzaco, 2021). Apart from that, a Biogas system is also available. (Tariku, 2020)

A comprehensive bread-baking system may include dividers, dough mixers, proofer cabinets, and other specialty equipment for different baking stages and gas-powered ovens. The seamless integration of these parts results in a streamlined and effective production line for bread and other baked items. (Roper, 2018). See plate two below.



PLATE 2 GAS BREAD BAKING SYSTEM

A steam bread baking system is an apparatus that bakes bread by harnessing the power of steam. A steam oven has many benefits when it comes to bread baking. By keeping the dough moist during the critical first baking phases, the steam creates the perfect baking environment for bread. When making bread in a steam oven, the procedure usually starts with preheating the oven and adding steam at the start of the baking cycle. This is frequently accomplished by adding water to the oven's reservoir, which causes steam to be released into the baking chamber at the proper moment. The right amount of steam is added carefully to produce a golden, crispy crust while enabling the bread to rise and take on the proper texture. (Silltoe, (2014).

In addition to conventional convection or radiant heat cooking, steam cooking is another technique in some steam ovens. This combination can produce bread with an open crumb structure and a gorgeously crisp crust. It's crucial to adhere to the manufacturer's instructions and any unique recipes or advice for baking bread in a steam oven when using one to bake bread. Use the steam function properly and pay attention to baking periods and temperatures to get the best results. When used for bread baking, a steam oven can be useful since it can produce artisan-style loaves with better texture and crust. (Sopoliga, 2016). See plate 3 below.



PLATE 3 STEAM BREAD BAKING SYSTEM

An appliance that generates heat for baking using electricity is called an electric bread baking system. Their precise temperature control, effortless operation, and reliable heating capabilities have made them immensely popular. Electric heating elements are used in electric bread-baking systems to provide the necessary heat for baking bread. These components, which provide uniform heat distribution for baking, are usually found at the top and bottom of the oven. Convection fans are another type of extra heating element found in some high-tech electric ovens. These fans circulate hot air to improve cooking performance. (Roger, 2015).

Systems for baking bread that run on electricity can keep temperatures constant and exact. This feature is especially helpful while baking because it guarantees that bread and other delicate pastries are cooked through without hot patches or temperature swings. Many electric bread-baking systems come with digital controls and displays that let users precisely set and keep an eye on the oven temperature. (Roger, 2015). See plate 4 below.



PLATE 4 ELECTRIC BREAD BAKING SYSTEM

The act of baking bread, cakes, cookies, and pastries in a home kitchen as opposed to a professional bakery is referred to as "domestic bread baking." Bread baking is a flexible procedure that yields a wide variety of breads, from artisanal sourdough breads to basic sandwich loaves, depending on the ingredients and methods used. Although high-end equipment is not required for baking at home, a few instruments are frequently used to make baking easier. These could consist of basic kitchen tools like whisks and spatulas, baking pans, parchment paper, cooling racks, measuring cups, spoons, and mixers (hand-held or stand). (Parker, 2019). For further studies, thermos-physical quantities can be determined by the density, specific heat, and thermal conductivity of the bread (Hadis, 2020)

MATERIAL AND METHOD

Material

The material that can conform with the operation in the construction and considering the condition of temperature at which the system will be subjected, also the cost of material needs to be analyzed. The right material for the fabrication of this project was stainless steel, especially steel of 316L standard (Amanov, 2020), UNSM treated at 400⁰C, which has very good temperature resistance, () also is durable () and very good for housing food(), but the cost of the steel () will not make the system affordable to the society. Mild steel was used for the fabrication, and as a prototype, 2mm thickness was used instead of 5 to 10mm. Mild steel has a melting point of. (). Mild steel has been malleable in bench operation (). In housing food, aluminum is as good as stainless steel to keep food clean. The melting temperature of aluminum is () ... Control of heat from direct contact with the baking pan made up of aluminum was used by employing gravel stones, these stones can retain heat and control heat as well, preventing direct contact with the aluminum pan which can easily melt due to low melting temperature and low thickness used.

Method

There was no foundry work as a method of production, no machining process involved, and no press work employed but only bench was involved. This was the reason completely hand tools were used in cuttings and joining processes.

Each component of the Domestic bread-baking System went through the activities of the bench operations, and these were measurement and marking out, cutting of the material, drilling, filing, and joining activities. Initially, the design of the baking system was as shown in the figure 1 below.

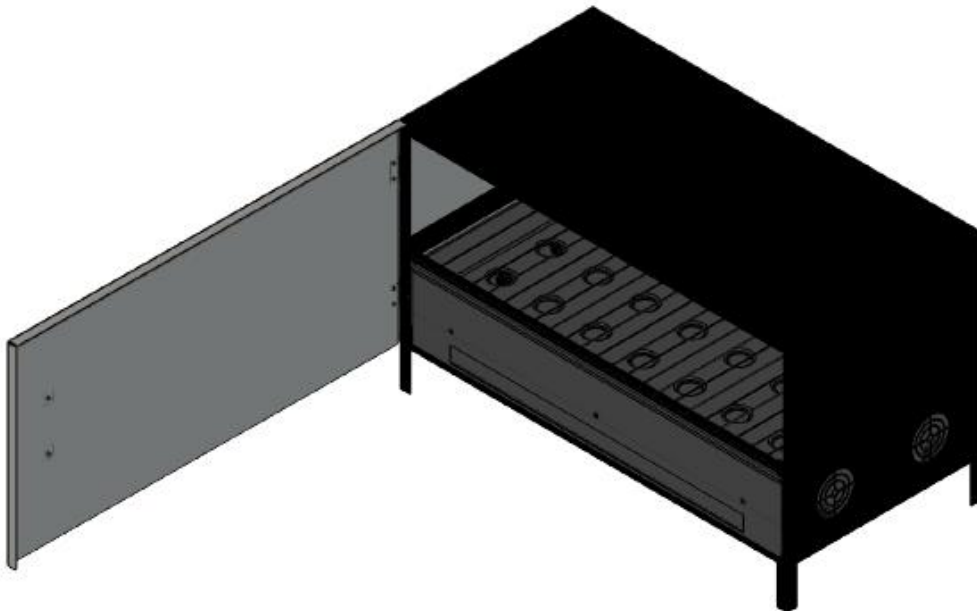


Figure 1 INITIAL DESIGN CHARCOAL BREAD BAKING SYSTEM

Exploded view of the baking system is shown in figure 2 below

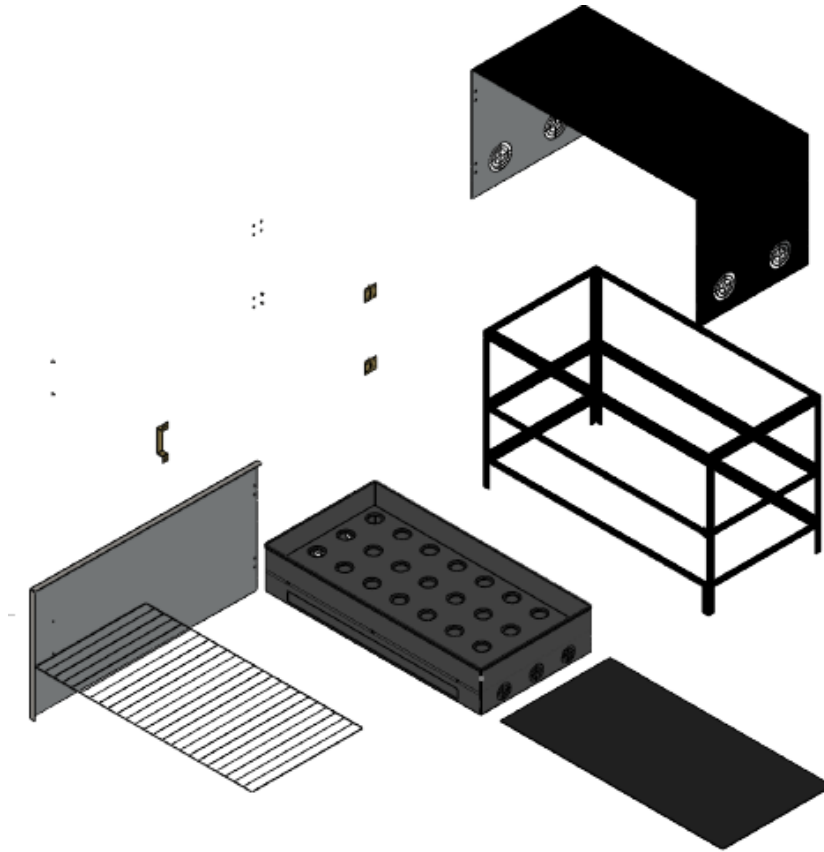


Figure 2 EXPLODED VIEW OF THE CHARCOAL BREAD BAKING SYSTEM

During the construction, the plan was amended because the design gave room for loss of heat especially the door by the side of the system, the door was supposed to be at the top of the system. The size of the system being domestic at the fabrication process was 36 by 24 inches.

As discussed earlier, the activities of bench operation were used for the fabrication of each of the following components;

Ashtray



PLATE 5 ASH TRAY

Mild steel of 2mm was used for the fabrication of the Ashtray. It is 34 X 20 inches. The ash of the charcoal used will be collected by the Ashtray.

Charcoal tray



PLATE 6 CHARCOAL TRAY

The Charcoal tray is completely perforated to allow the ash to reach down the Ashtray, the same material and all dimensions were used.

Body frame, Cover, and Frame for lagging cavity



PLATE 7 FRAMES, COVER AND LAGGING CAVITY

The body frame, cover of the system, and preparation for lagging can be seen moving ahead for the fabrication. The dimensions of both the Body frame and the Cover are the same 36 X 24 inches while 2 inches gap was given between the Body frame and the lagging frame.

Heat Chamber



PLATE 8 HEAT CHAMBER

Immediately after the charcoal chamber is a Heat chamber separated by the diaphragm of a wire mesh. Also, the frame for the lagging is fixed and can be seen as shown in the plate 8 above.



PLATE 9 VIEWS OF THE CHARCOAL BREAD BAKING FABRICATION

Different views of the system can be seen where the cover has been closed, at the side view Fan housing can be set to accommodate the fan helping the charcoal to ignite after which will be switched up to prevent the fire from running down. The lagging was done using clay sand to prevent heat loss, lagging can be seen in plate 10 shown below. Five large baking pan also are seen in plate 10.

Baking system after painting before lagging



PLATE 10 CHARCOAL BREAD BAKING SYSTEM BEFORE AND AFTER LAGGING

The baking pans were placed on gravel stones to retain heat and prevent direct heating of aluminium baking pan as shown in plate 11.



PLATE 11 BAKING PAN ON GRAVEL STONES

TEST AND RESULTS

The process started with preparing the flour and bread components and letting them sit for half an hour.

Second, give the heat zone a fifteen-second preheats.

The baking pans were then put inside the oven when the temperature hit 50 degrees Celsius. When the ovum reached 70°C every cycle, either ten or five bread slots could be baked in thirty minutes; however, this was only possible for the 10 and 5 pieces of bread, which weighed 50g and 100g, respectively.

DISCUSSION

The domestic bread-baking system was put to the test to determine its functionality and effectiveness through baking the bread. After the domestic baking system had been tested, it was realized that it was economical, efficient, and faster.

RECOMMENDATIONS

It was suggested that a control panel, sensor, ventilation system, thermostat, and temperature control system be included. This will enhance the latest technology.(Sci & Tech, n.d.)

REFERENCES

- Amanov, A. (2020). Effect of local treatment temperature of ultrasonic nanocrystalline surface modification on tribological behavior and corrosion resistance of stainless steel 316L produced by selective laser melting. *Surface and Coatings Technology*, 398, 126080. <https://doi.org/10.1016/j.surfcoat.2020.126080>
- Hadis, A. Z. (2020). Estimation of thermo-physical properties of selected Ethiopian indigenous foods and industrialization of Tef injera, traditional bread. *Journal of Agroalimentary Processes and Technologies*, 26(4), 265–270. https://www.journal-of-agroalimentary.ro/Journal-of-Agroalimentary-Processes-and-Technologies-Article_mN117z.html
- Numanovich, A. I., & Abbosxonovich, M. A. (2020). THE ANALYSIS OF LANDS IN SECURITY ZONES OF HIGH-VOLTAGE POWER LINES (POWER LINE) ON THE EXAMPLE OF THE FERGANA REGION PhD of Fergana polytechnic institute, Uzbekistan PhD applicant of Fergana polytechnic institute, Uzbekistan. *EPRA International Journal of Multidisciplinary Research (IJMR)-Peer Reviewed Journal*, 2, 198–210. <https://doi.org/10.36713/epra2013>
- Sci, A. J., & Tech, E. (n.d.). *Advance Journal of Science , Engineering and Technology EFFECT OF THE INTRODUCTION OF LAND INFORMATION MANAGEMENT SYSTEM ON Advance Journal of Science , Engineering and Technology*. 32–44.
- Tariku, A. (2020). *Addis Ababa Science and Technology University Design , Development and Performance Evaluation of an Improved Biogas Injera Baking Stove Design , Development and Performance Evaluation of an Improved Biogas*.