International Research Journal of Science and Technology, Volume 2, Issue 2, (2021), 374-378

Available online at https://www.irjst.com/
International Research Journal of Science and Technology
ISSN: 2707-3955
DOI: https://doi.org/10.46378/irjst.2021.020202

Microbial and Physicochemical Profile of Branded and Unbranded Groundnut Oil

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Paper Status
Received : Dec 2020
Accepted : Feb 2021
Published : Mar 2021

Abstract

Processed food products have shown high potentials to be contaminated in suitable environmental conditions. Groundnut oil is one of such products. The study was conducted to determine the safest branded and unbranded groundnut oil sold in markets. Total bacterial count and Total fungal count were evaluated using standard microbiological methods. The result obtained showed that all the branded oil was free from bacterial contamination since they went through a series of refining processes. Although, they were contaminated with fungi. All the unbranded groundnut oil had bacterial and fungal contaminations of species which include; Bacillus (20%), Staphylococcus (20%), Enterobacter (6%), Micrococcus (27%), Fusarium, and Aspergillus sp. The total heterotrophic bacteria count for the unbranded groundnut oil samples ranged from 9.4×10^2 to 2.3×10^2 cfu/ml while total fungal counts for unbranded groundnut oil samples ranged from 5.5×10^0 and 2.0×10^0 cfu/ml. The total bacterial count for branded groundnut oil ranged from 3.0×10^0 and 2.0×10^0 which were within acceptable standards. The physicochemical parameters for unbranded groundnut oil did not exceed the acceptable limit. Nevertheless, consumers are encouraged to use more refined and branded groundnut oil as these fall closer to acceptable standards than regular unbranded ones.

Key Words
Groundnut oil
Staphylococcus
Heterotrophic bacteria

Citation: Omorodion Nnenna, Emuejeraye Sophia. "Microbial and Physicochemical Profile of Branded and Unbranded Groundnut Oil" International Research Journal of Science and Technology, 2 (2), 374-378, 2021.

1. Introduction

Oils constitute one of the essential components of a balanced diet as it is a good source of energy. It is a major source of plant-based protein. Vegetable oil is the general name given to oils gotten from plants seeds or fruits. Vegetable oil can be defined as plant oils gotten from the seeds or fruits of plants, composed primarily of glycerides of fatty acids obtained from vegetable and plant sources [1]. They contain little amount of lipids like phosphatides of unsaponifiable constituents and free fatty acids. Vegetable oils are liquid at room temperature. Groundnut oil is organic edible oil obtained from groundnut kernels.

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Groundnuts are believed to have originated from the Central American region from where they spread to another part of the world Spanish explorers. Groundnut plant is a low-growing annual plant belonging to the family of Leguminosae of the genus Arachis with the botanical name Arachis hypogea. It is the 13th most important food crop and the second most important oilseed crop in the world. It is cultivated mostly in tropical regions and its major producing countries are India, China, Nigeria, the USA, and Indonesia with total metric tons production of 35.9 million [2]. Groundnut oil is available in markets in refined and filtered forms and some are more superior to others.

Branded oils are usually properly refined before distribution to the general public. Hence, there is usually little or no microbial growth in them when cultured. Branded oils are a group of oils with a brand name and logo. They are obtained from plant-based

sources using a process of solvent extraction. They are made by highly intensive and chemical solvent extraction processes. The crushed seeds are heated at a temperature between 110°C and 180°C in a steam bath to start the oil extraction process. Locally made oils do not go through a rigorous process when they are made. Hence, contamination is likely to arise. They are obtained by pressing the vegetable material to extract the oil. Unbranded oils are those without a brand name or logo and are most times not properly refined. Hence, bacterial and fungal contamination is seen when cultured Groundnut was introduced in Nigeria by the Portuguese traders in the 1800s and became popular as it became useful for food and trade. Production in Nigeria increased drastically. As of 2007, Nigeria became the world's 3rd largest producer of groundnut, producing about 11% of total groundnut in the world. Kano, Jigawa, Katsina, Kaduna, and Jos are the major states in which groundnut is cultivated in Nigeria A major factor that has promoted the growth of groundnut in Nigeria is the free market system.

Three groundnut varieties have been adopted in the Kano, Jigawa, and Katsina states of Nigeria. The Virginia and Valencia groups are the most popular cultivars because of their large seed. As to production constraint, groundnut production in Nigeria faces drought coupled with poor storage conditions, insect, pest, and disease attacks which have resulted in the decline of groundnut production and a southward shift of suitable climatic zones for groundnut production.

Due to the ubiquitous nature of microorganisms, they tend to be present in almost everything provided there is adequate nutrient to enable their growth. Some microorganisms associated with groundnut oil include: Micrococcus, Bacillus, Staphylococcus, Klebsiella, and fungi such as Moulds, Aspergillus, Fusarium. Some of these microorganisms may be pathogenic when the oil is consumed raw.

The food and agriculture organization in 2002 estimated that 25% of the world's crops and products gotten from food crops are affected by mycotoxins as a result of contamination from fungi. It has also been stated that storage conditions may increase the number of microorganisms in oil. Experiments have authenticated the presence of Bacillus, Staphylococcus, Salmonella, Aspergillus, and moulds species in oil samples. Some organisms that grow on oil samples may lead to an increased moisture content of the oil.

Several shopkeepers sell unbranded groundnut oil which according to health experts, pose serious health threats to the general public when consumed. The hygienic state of these unbranded groundnut oils cannot be guaranteed. The branded or refined groundnut oil presents a better alternative to the unbranded oil. This work intends to compare both oil samples and correlate their differences, if any, in terms of their microbial quality, heavy metals and elements content, and whether or not the refining processes have a significant impact. To identify microorganisms associated with branded and unbranded groundnut oil and also to compare results with approved world health organizations and the national agency for food and drugs administration commission standards.

2. Materials and Methods

2.1 Sample Collection

Samples of groundnut oil were purchased from local markets.6 samples of branded oils were sampled and labeled as A, B, C, D, E, F, and 6 unbranded oils all properly labeled.

2.2 Preparation of Sample

Samples were placed in sterile labeled bottles and first diluted in ringer's solution for emulsification. Plates counts agar and potato dextrose agar was used and prepared according to manufacturer's standard. All materials used were sterilized in an autoclave at 121°C at 15psi for 15 minutes and by dripping ethanol and flaming.

2.3Serial Dilution

The oil sample was diluted in the ringer's solution. A 10-fold serial dilution was done. 9mls of ringer's solution was dispensed into 4 test tubes. 1mls of each sample was diluted in 9 ml of diluent (ringer's solution). About 0.1 ml of sample was plated directly on media to obtain dilution 10^0 and 0.1 ml of diluents was plated on media to obtain dilution 10^{-1}. This was done in duplicate. The sample was spread homogenously using a sterile spreader and spread plate technique. PDA plates were placed in the incubator for 5 days, while PCA plates were placed in an incubator for 24 hours.

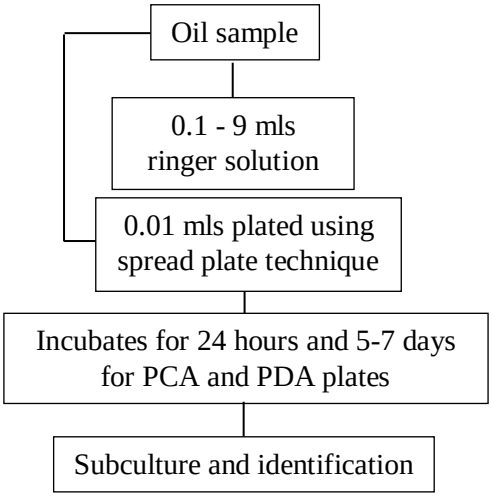


Figure 1. Flowchart for methodology

2.4 Microbiological Analysis of Sample

Microbiological examination of food provides information about the quality of raw or processed food, sanitary condition, and effectiveness of the various methods of preservation. Isolates were analyzed for viable bacterial and fungi load. Organisms were identified after carrying out biochemical tests, using standard methods. Bacterial isolates were identified based on their colonial morphology, microscopic examination, and biochemical. The test performed were Gram staining, Catalase, Methyl red and Voges Proskauer (MR VP test), Oxidase test, Starch hydrolysis, Citrate, and Indole test.

In the identification of isolates, cultural and biochemical characterization of isolates was carried out using the standard methods for both fungal and bacterial isolates. The bacterial isolates were identified based on their colonial morphology, microscopic examination, and biochemical characteristics.

The mold isolates were examined macroscopically to know the cultural characteristics. A portion of the mold growth on malt extract agar was picked with a sterile inoculating needle and placed on a drop of Lactophenol cotton blue on a clean microscopic slide and then examined microscopically. Following the examination of the mould isolates in conjunction with the cultural characteristics as well as the back view of the plates, the molds were identified.

Microscope for the identification of fungi isolates, morphological examination was done according to Kirk (2009). The isolated fungi cultures were maintained on 4% PDA slants.

3. Results and Discussion

The microflora of edible oil reflects the quality of oil, the sanitary conditions of the equipment used to manufacture the oil, and the environmental conditions during packaging and handling of the products, Bacterial growth is minimal and mostly insignificant in oil as explained in a report by Gobena et al., in 2018, but because of the favorable moisture content, fungi growth is rapid. Hence, there was no heterotrophic bacterial growth in branded groundnut oil samples owing to proper refined procedures. The microbiological analysis carried out showed that although within standards as stated by the international commission on microbiological specifications for foods (ICMSF) that bacterial load should not exceed 5×10^5 CFU/ml, accumulation of pathogenic organisms may be detrimental to human health especially when consumed without proper heating (over 90 degrees). The high microbial content of the unbranded groundnut oil can be attributed to the contamination of mature groundnut seeds when harvested and stored over a long period. Microbiological quantity of samples that exceeded standards suggests the poor local production processes and poor handling of the samples before they are made available to the consumers. These nuts are susceptible to spoilage and the absence of proper industrial purification processes which can lead to an increase in moisture content which favors the growth of Fungi.

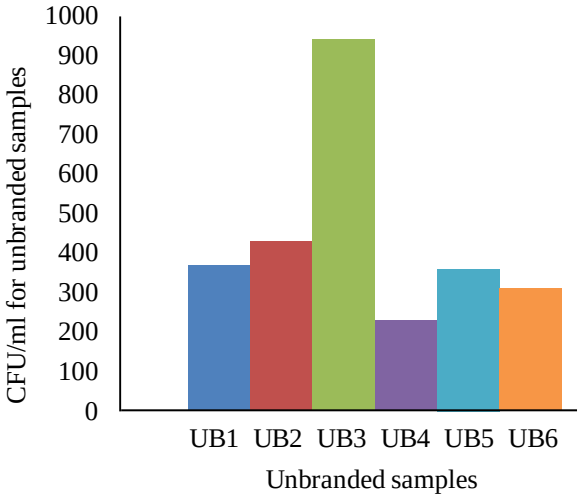
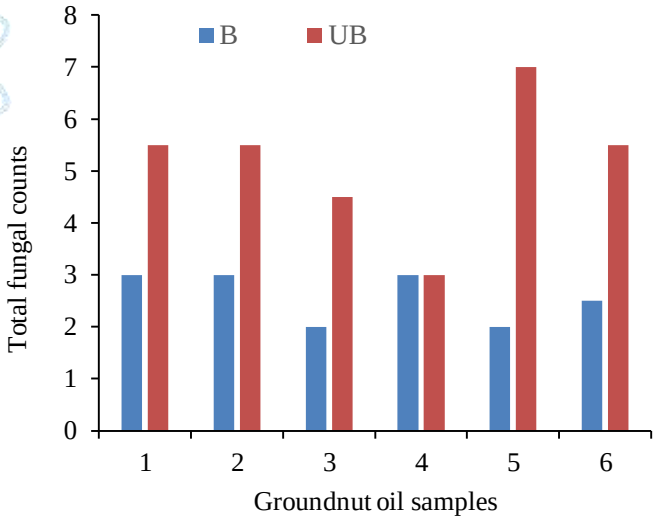


Figure 2. Total heterotrophic bacteria count of unbranded groundnut oil



B: Branded Groundnut Oil; UB: Unbranded Groundnut Oil

Figure 3. Total fungal counts for branded and unbranded groundnut oil samples

The highest total heterotrophic bacteria count for the unbranded sample of the unbranded groundnut oil sample was sample 3 (9.0×10^2) and the least was sample 4 (2.3×10^2). The highest pathogenic species isolated from the un-branded sample is Micrococcus sp. with 27% followed closely by Bacillus sp. Staphylococcus sp. and Corynebacterium sp. with 20%. Enterobacter sp. and Klebsiella sp. had 6% and 7% occurrence levels respectively. Micrococcus sp. is a gram-positive bacteria that occurs in clusters and only becomes pathogenic when opportunity and can

cause bacteria, arthritis, and pneumonia. Bacillus sp., Staphylococcus sp. and Corynebacterium sp. are the chief pathogenic organisms. Bacillus is an anaerobic bacterium producing endospores that cause disease once it gets into the human body and is likely to cause deterioration of the oil [3] Staphylococcus are gram-positive bacteria that cause various skin infections and food poisoning. Corynebacterium is a gram-positive bacteria and is the causative agent of diphtheria and other acute diseases. Similar results were obtained from the study conducted by Okechalu et al., which indicated poor hygiene practices [3].The presence of Aspergillus and other molds with counts of 5.5×10^{1} were nearly similar to results obtained in a report by Lidiya et al., this causes rapid deterioration of the groundnut oil and ultimately leads to spoilage. The percentage of occurrence of Fusarium is 3% and its presence in the samples suggests the presence of mycotoxins which is harmful to health when consumed. All elements and metals were within standards as indicated [2].

Physicochemical Analysis

The physicochemical analysis of groundnut oil was used to test for elements and metals in both branded and unbranded groundnut oil samples. The values for the elements and metals in unbranded groundnut oil was higher than that of branded.

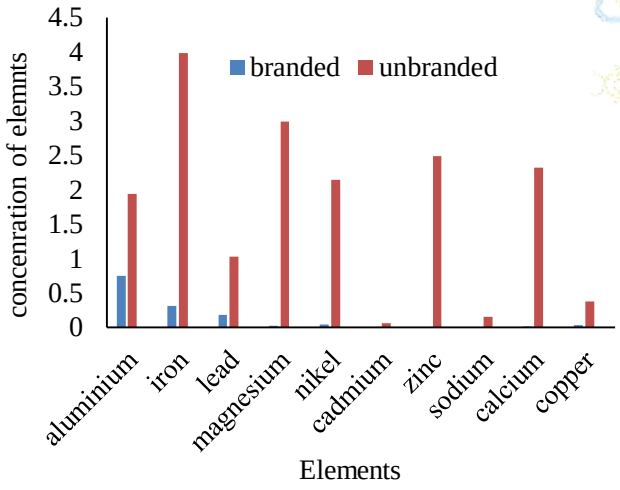


Figure 4. Heavy metals level in branded and unbranded groundnut oil

The result of the metal analysis showed that iron in the branded groundnut oil sample was within standards when compared to a report by Ali et al.,(2005). In his report, the concentration of some metals in food samples showed that although iron is good for the body, once in excess, might lead to accumulation in the body, damaging tissues. The concentration of copper was within standards as stated in a report [4]. The maximum amount of copper tolerable by a healthy man or woman is 0.9mg/kg. The recommended WHO standard is a maximum of 1.3mg/day. [5].

The concentration of lead above 10µg/dl is a cause for concern when accumulated over time. Both samples contained traces of lead, although not in excess. The presence of lead in even very small proportions may become harmful and should be reduced to the lowest possible level to avoid neurological side effects, fetus abortion, and complications in younger children.

4. Conclusions

Vegetable oils and fats contain various trace elements in small amounts depending on various factors; soil used in cultivation, storage conditions, pollution, irrigation, and a host of others. Although the concentrations of these trace elements are within standard, accumulation in the body over time might be harmful; hence, consumption should be strictly monitored. In Nigeria, producers of groundnut oil are encouraged to fortify their products with vitamin A to improve the quality. This is enforced by WHO and FAO and strongly supported by other regulatory bodies. This and many other factors may be the cause of variations observed. The presence of some microorganisms can pose health hazards ranging from adverse effects like death, blurred vision, or total loss of vision and impaired hearing to consumers, therefore improvement is required in the production and distribution of locally made groundnut oils. Consumers are encouraged to use refined groundnut oil.

5. Recommendations

The human body uses oil for three main purposes; as energy sources, as structural components and to make powerful biological regulators. However, the detrimental intake of metals in oils arises from accumulation over time and the detrimental effects can be managed as follows;

- Regulatory measures for constant monitoring of the unbranded groundnut oil into local markets.
- Dumping of refuse around plants and indiscriminate dumping of refuse should be discouraged.
- Cleaner production programs should be practiced.
- Further researches should be made such that food samples that are not within acceptable limits are recalled.
- Producers should also fortify their products with vitamin A.
- Proper refining procedures should be strictly observed.

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