OPEN ACCESS PEER REVIEW

DOI: https://doi.org/10.52756/lbsopf.2024.e02.002

Chapter- 2

Determination of Nutritional Quality Between Indigenous and Imported Cashew Nuts

Apurba Bhunia, Sourav Bar, Sujit Das, Sudipta Kumar Ghorai*, Bhanumati Sarkar, Biplab Kumar Behera

Keywords: Cashew nuts, African, Indigenous, Saponification, Nutritional, Edible oil

Abstract:

Anacardium occidentale, commonly known as the cashew tree, is native to Brazil but is now grown globally. Cashew nuts, harvested from these trees, are in high demand, leading India to import them from African countries. In a study comparing indigenous and imported cashew nuts, three nutritional parameters were examined: acid value, saponification value, and iodine value. The findings revealed that the acid values for indigenous and imported cashew nuts were 0.48 mg KOH/g and 0.45 mg KOH/g, respectively. The saponification values were 156 mg KOH/g for indigenous nuts and 148 mg KOH/g for imported ones. The iodine values were 48 mg KOH/g for indigenous and 51 mg KOH/g for imported nuts. These results indicate that the nutritional parameters are quite similar between the two types of cashew nuts. Despite popular belief that indigenous cashews have superior nutritional quality compared to imported ones, the study found no significant nutritional difference. The distinction lies in taste, attributed to natural sugar content, which was not analyzed in this study. Both types of cashew nut oil are nutritionally superior to many other edible oils available in the market, making cashew nut oil a viable alternative oil source.

Introduction:

Cashew nuts are harvested from the *Anacardium occidentale* tree, a species originally from Brazil but now cultivated around the world (Assunção et al., 2003). Renowned for their nutritious and delicious qualities, cashew nuts are unique because they grow outside the fruit, attached to a

Apurba Bhunia
Coastal Ecology Research Laboratory, Egra SSB College, under Vidyasagar University, West Bengal, India
Sourav Bar
Coastal Ecology Research Laboratory, Egra SSB College, under Vidyasagar University, West Bengal, India
E-mail: souravbar89@gmail.com
Orcid iD: https://orcid.org/0009-0003-9690-6893
Sujit Das
Coastal Ecology Research Laboratory, Egra SSB College, under Vidyasagar University, West Bengal, India
E-mail: sdas60576@gmail.com
Orcid iD: https://orcid.org/0009-0007-1920-6788
Sudipta Kumar Ghorai*
Coastal Ecology Research Laboratory, Egra SSB College, under Vidyasagar University, West Bengal, India
E-mail: sudiptag8@gmail.com
Orcid iD: https://orcid.org/0000-0003-3478-3632
Bhanumati Sarkar
Department of Botany, Acharya Prafulla Chandra College, New Barrackpore, West Bengal, India
E-mail: bsarkar328@gmail.com
Orcid iD: https://orcid.org/0000-0001-9410-9311
Biplab Kumar Behera
Department of Zoology, Siliguri College, Siliguri, West Bengal, India
E-mail: biplab_11@rediffmail.com
***Corresponding Author**: sudiptag8@gmail.com

Dr. Somnath Das, Dr. Latoya Appleton, Dr. Jayanta Kumar Das, Madhumita Das (eds.), Life as Basic Science: An Overview and Prospects for the Future Volume: 2. ISBN: 978-81-969828-6-7; pp. 35-43; Published online: 30th June, 2024

cashew apple, which itself is used to produce various beverages. Rich in nutrients, cashew nuts offer numerous health benefits (Mandal, 2016, 2019, 2020). Although India is a significant producer of cashew nuts, the high demand necessitates imports from countries like Ghana, Tanzania, Nigeria, and others. The comparison of the nutritional quality of imported and indigenous cashew nuts was done by extracting oil from cashew seeds. The composition of edible oils was assessed through various physical and chemical properties (Ceriani et al., 2008). Several key parameters such as acid value, saponification number, and iodine value were evaluated which helped to determine oil quality.

The acid value measures the free fatty acids and glycerol produced when triglycerides break down, with a high acid value indicating old or rancid oil, which can be harmful to health (Borkar et al., 2015). A higher saponification value suggests shorter fatty acid chain lengths and lower molecular weights. The iodine value measures the degree of unsaturation in oil or fat (Ekwu et al., 2004). Analyzing these nutritional parameters allows us to identify the differences in nutritional quality between indigenous and imported cashew nuts.

A B

Figure 1. Cashew tree (*Anacardium occidentale*) (Picture courtesy: A. Naturepl.com B. ScienceDirect).

A B

Figure 2. (A) Indian variant of cashew nuts (2B) and African variant of cashew nuts.

Materials and Methods

Seed collection

Two different varieties of cashew nuts (*Anacardium occidentale*), specifically the African and Indian variants, were obtained from a nearby local cashew processing store in Purba Medinipur, West Bengal (21˚78′ 13"N, 87˚65′97"E). The seeds were cleaned to remove impurities and then air-dried.

Oil Extraction

Extraction was done following several steps using Soxhlet extraction method (Tyman et al., 1989). The dried seeds were ground using a grinder, and the resulting crushed seeds were placed into filter paper bags. These bags were then inserted into a Soxhlet extractor. A round bottom flask was filled with 100 ml of petroleum ether, the chosen solvent. The Soxhlet extractor was connected to a distillation apparatus, and the distillation process was initiated to extract the desired sample. Once the process was completed, the round bottom flask was transferred to a rotavapor to evaporate the solvent from the sample. The extracted oil, obtained after solvent removal, was then used for further analytical procedures.

Figure 3. Extraction of oil using Soxhlet apparatus.

The analytical method

Acid value

The acid value can be determined through a series of steps and calculations (Liu et al., 2019). A 1.0 g sample of oil was accurately weighed and dissolved in 50 ml of neutralized alcohol. To this solution, 2 to 3 drops of phenolphthalein indicator were added. The mixture was then titrated with a 0.1N potassium hydroxide (KOH) solution until a pale pink color persisted, indicating the endpoint of the titration. This color change signifies that the free fatty acids in the oil sample have been neutralized by the KOH solution. The acid value, which reflects the free fatty acid content of the oil and is an important parameter for assessing oil quality, was then calculated using the following formula:

Acid value = (V x 0.00561 x 1000)/weight of sample

V = Volume of 0.1N KOH consumed by oil.

Saponification Value

The saponification value can be determined through several key steps and calculations (Eddy et al., 2011). To prepare the N/2 alcoholic KOH solution, 7.0 g of potassium hydroxide (KOH) was dissolved in 20 ml of distilled water and then mixed with 230 ml of 95% ethanol. This mixture was allowed to sit for 24 hours before being filtered. The alcoholic KOH solution was then standardized using an N/2 oxalic acid solution.

For the analysis, a 1 g sample of oil was weighed and placed into a 250 ml flat-bottom flask. To this, 25 ml of the N/2 alcoholic KOH solution was added. The mixture was heated for 30-40 minutes to ensure complete dissolution of the oil sample. After heating, the solution was allowed to cool to room temperature. Subsequently, two drops of phenolphthalein indicator were added, and the mixture was titrated with hydrochloric acid (HCl) solution until the pink color disappeared. This endpoint signifies the neutralization of the KOH by the HCl. A blank determination, conducted under the same conditions, was also performed to ensure accuracy and reliability of the results. This analytical method is essential for determining the saponification value of the oil, which provides information about the average molecular weight of the fatty acids present in the sample.

Saponification number = (B - T) x N x 56.1/W

B= ml of HCl required by blank

T= ml of HCl required by sample

N = Normality of HCl

W= Weight of oil in gm

Iodine Value

The iodine value of the oil sample was determined using the Wijs Method (Noor et al., 2015). To prepare the Wijs solution, 16.2 g of iodine monochloride (ICl) was dissolved in glacial acetic acid in a 1-liter volumetric flask. For the analysis, a 1 g sample of oil was dissolved in 15 ml of carbon tetrachloride. Then, 25 ml of the Wijs solution, 100 ml of water, and 15 ml of a 10% potassium iodide solution were added to the mixture, which was then stored in a dark place for 30 minutes to allow the reaction to proceed.

After the incubation period, the solution was titrated with a standardized thiosulfate solution until a straw color was observed. At this point, 1 ml of starch indicator was added, turning the solution blue. The titration continued until the blue color disappeared, indicating the endpoint of the reaction. A blank titration, conducted under the same conditions, was also performed to ensure the accuracy of the measurements. This method measures the degree of unsaturation in the oil, as the iodine reacts with the carbon-carbon double bonds in the fatty acids, providing important information about the oil's chemical properties and quality.

Iodine value = [(Titer value of blank - titer value of oil samples) ml x 0.01269 x 100]/ Weight of oil sample (g).

Result

Acid value

The acid value of an oil measures the quantity of free fatty acids (FFA) present. It is defined as the number of milligrams of potassium hydroxide (KOH) needed to neutralize the FFAs in one gram of oil. A higher acid value typically indicates a greater amount of FFAs, which often suggests the oil is older or of lower quality. Conversely, a lower acid value is associated with fresher, higher-quality oil. The acid value is an essential parameter for assessing the condition and usability of oil in various applications, such as cooking and industrial processes. It is important because high levels of FFAs can lead to undesirable flavors, odors, and reduced shelf life in edible oils, while in industrial oils, it can affect performance and stability.

Table 1. Comparison of acid values of different edible oils (Source: Ichu and Nwakanma, 2019).

Sl. No.	OIL	ACID VALUE (mg KOH/g)
1.	Mustard oil	0.56
2.	Soya oil	0.35
3.	Coconut oil	0.31
4.	Palm kernel oil (PKO)	2.75
5.	Palm oil	2.67
6.	Sesame oil	1.34
7.	India variant cashew nut oil	0.48
8.	African variant cashew nut oil	0.45

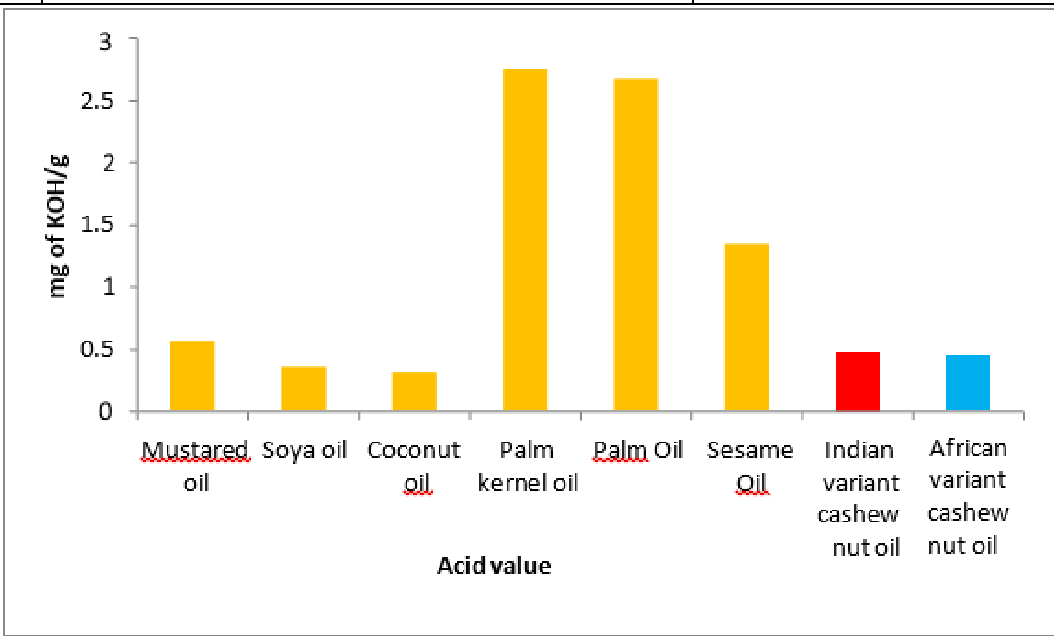

Figure 4. comparison of Acid Values between different edible oils and two types of Cashew nut oils.

Saponification value

The saponification number provides insights into the average chain length of fatty acids within a fat or oil, which helps determine their molecular weight. Specifically, it indicates the number of milligrams of potassium hydroxide (KOH) required to completely hydrolyze one gram of fat or oil. Essentially, it measures the amount of KOH needed to neutralize the fatty acids. A longer fatty acid chain suggests lower acidity, resulting in reduced KOH consumption. Conversely, shorter fatty acid chains lead to a higher saponification number, as more KOH is needed for neutralization. This metric is crucial for understanding the composition and quality of fats and oils, impacting their applications in industries like soap making, where the saponification number directly influences the quality and characteristics of the final product.

Table 2. Comparison of saponification values of different edible oils (Source: Ichu and Nwakanma, 2019).

Sl. No.	OIL	SAPONIFICATION NUMBER (mg KOH/g)
1.	Mustard oil	230
2.	Soya oil	196
3.	Coconut oil	252
4.	Palm oil	160
5.	Sesame oil	185
6.	India variant cashew nutoil	156
7.	African variant cashewnut oil	148

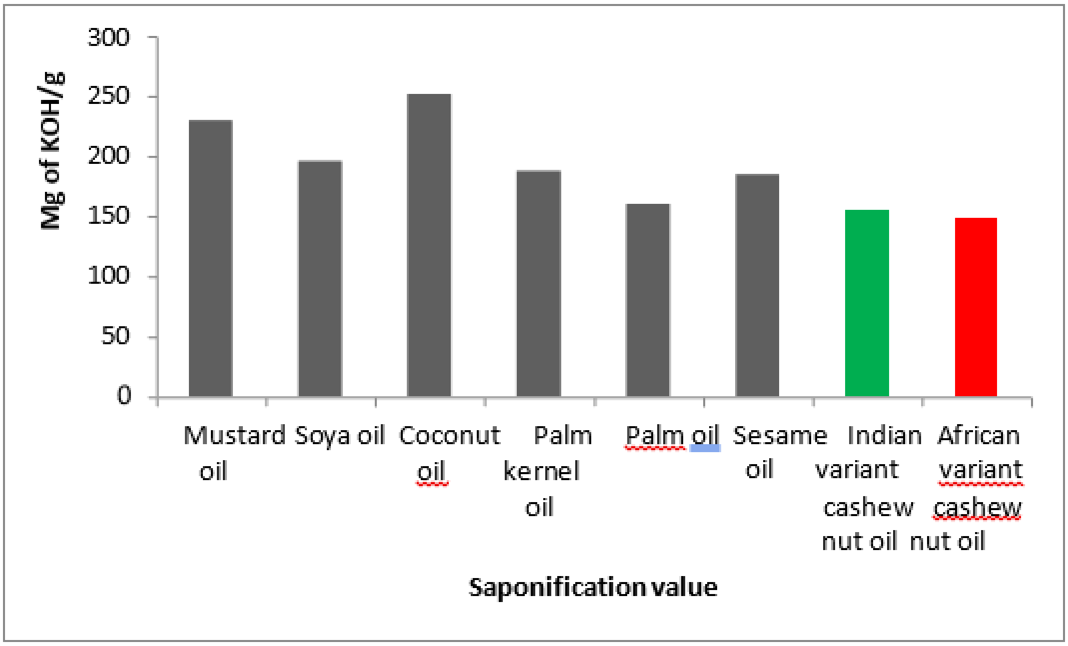

Figure 5. Saponification values of different edible oils and Cashew nut oils.

Numerous physicochemical parameters are used to evaluate the nutritional value of an oil. Among these, acid value, saponification value, and iodine value stand out as three key indicators. The acid value measures the free fatty acid content, indicating oil quality and age. The saponification value reveals the average chain length of fatty acids, providing insight into their molecular weight. The iodine value assesses the degree of unsaturation in the oil, reflecting its stability and potential health benefits. These parameters are crucial for determining the overall quality, nutritional profile, and suitability of oils for various applications, including culinary and industrial uses.

Table 3. Different Iodine values of edible oils Source: (Seneviratne & Jayathilaka, 2016).

Sl. No.	OIL	IODINE VALUE
1	Canola oil	115
2	Soya oil	132
3	Coconut oil	9
4	Sunflower oil	127
5	Olive oil	84
6	Sesame oil	110
7	India variant cashew nut oil	48
8	African variant cashewnut oil	51

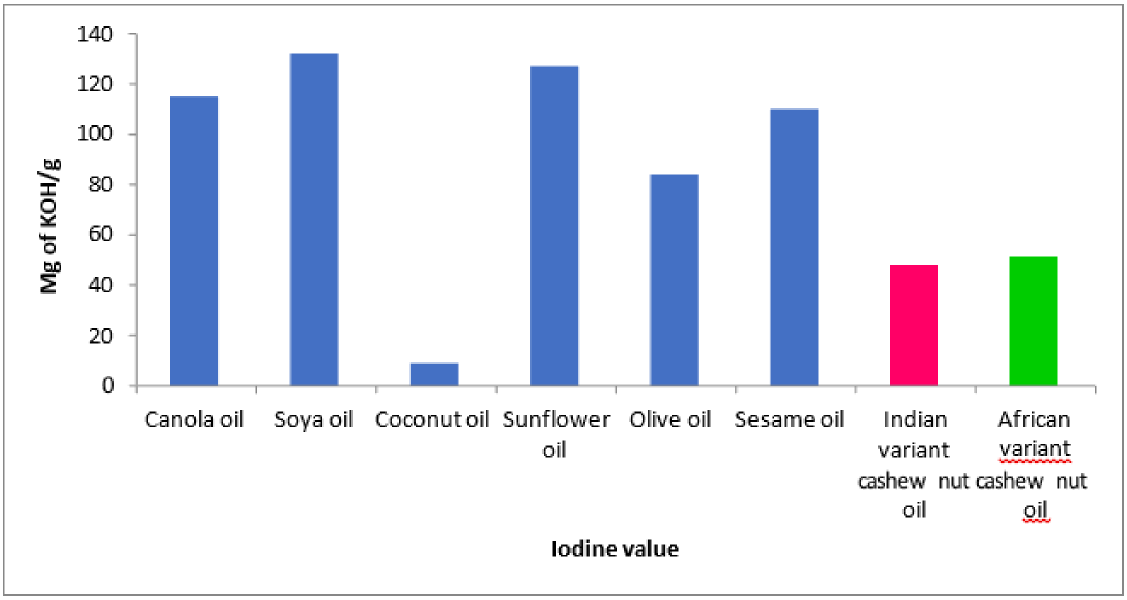

Figure 6. Comparison of iodine values between two cashew nut oils as well as different edible oils.

Iodine value

The iodine value is defined as the number of grams of iodine absorbed by 100 grams of oil or fat. This parameter indicates the degree of unsaturation within the oil, with higher iodine values reflecting greater unsaturation. The iodine value is essential for assessing the stability and shelf life of oils, as more unsaturated oils are prone to oxidation and rancidity. Additionally, it provides insight into the nutritional aspects of the oil, as unsaturated fats are generally considered healthier than saturated fats. This measurement is crucial for various industries, including food and cosmetics, where the chemical properties of oils directly impact product quality and performance.

Discussion

The nutritional values, including acid value, saponification value, and iodine value, are nearly identical in two different types of cashew nut oil. Both types of cashew nut oil exhibit superior nutritional quality compared to other edible oils commonly available on the market. However, cashew nuts are more expensive than other oil seeds, making cashew oil less affordable for everyday use. The primary difference between these two types of cashew nut oils lies in their taste, which is influenced by their sugar content. Although the sugar content was not analyzed in this chapter, it is a factor that could be investigated in future studies.

Conclusion

There is a common belief that indigenous cashew nuts possess superior nutritional quality compared to imported ones. However, studies have shown that there is no significant nutritional difference between them. Both types of cashew nut oil exhibit excellent nutritional profiles, comparable to other commonly available edible oils on the market. This makes cashew nut oil a viable alternative oil source. Despite the higher cost of cashew nuts, their oil remains a nutritious option, offering potential health benefits and versatility in various culinary applications.

References

Assunção, R. B., & Mercadante, A. Z. (2003). Carotenoids and ascorbic acid from cashew apple (*Anacardium occidentale* L.): variety and geographic effects. *Food Chemistry*, *81*(4), 495-502. https://doi.org/10.1016/S0308-8146(02)00477-6

Ceriani, R., Paiva, F. R., Goncalves, C. B., Batista, E. A., & Meirelles, A. J. (2008). Densities and viscosities of vegetable oils of nutritional value. *Journal of Chemical & Engineering Data*, *53*(8), 1846-1853. https://doi.org/10.1021/je800177e

Borkar, V. S., Kumaran, K. S., Kumar, K. S., Gangurde, H. H., & Chordia, M. A. (2015). Antioxidant effect and characterization of bioactive constituents isolated from *Echinochloa colona* (Poaceae). *World J. Pharmaceut. Res.*, *4*, 1652-1661.

Ekwu, F. C., & Nwagu, A. (2004). Effect of processing on the quality of cashew nut oils. *J. Sci. Agric. Food Tech. Environ.*, *4*(2004), 105-110.

Tyman, J. H. P., Johnson, R. A., Muir, M., & Rokhgar, R. (1989). The extraction of natural cashew nut-shell liquid from the cashew nut (Anacardium occidentale). *Journal of the American Oil Chemists' Society*, *66*(4), 553-557. https://doi.org/10.1007/BF02885447

Liu, Y., Li, X., Liang, Y., Liang, J., Deng, D., & Li, J. (2019, August). Comparative study on the physicochemical characteristics and fatty acid composition of cashew nuts and other three tropical fruits. IOP Publishing, In *IOP Conference Series: Earth and Environmental Science, 310*(5), pp. 052011. https://doi.org/10.1088/1755-1315/310/5/052011

Eddy, E. O., Ukpong, J. A., & Ebenso, E. E. (2011). Lipids Characterization and industrial potentials of pumpkin seeds (*Telfairia occidentalis*) and cashew nuts (*Anacardium occidentale*). *Journal of Chemistry*, *8*(4), 1986-1992. https://doi.org/10.1155/2011/974343

Mandal, S. (2016). The nutritional health factors of Cashewnut (*Anacardium occident ale* L.). *Int. J. Exp. Res. Rev.*, 7, 18-20.

Mandal, S. (2019). Biochemical profile of Cashew nut *Int. J. Exp. Res. Rev.*, *20*, 48-50. https://doi.org/10.52756/ijerr.2019.v20.005

Mandal, S. (2020). Stigma receptivity in Cashew nut (Anacardium occidentale L.). *Int. J. Exp. Res. Rev.*, *21*, 37- 39. https://doi.org/10.52756/ijerr.2020.v21.005

Noor, A., Mwangi, P., Kareru, P., & Thiongo, G. (2015). Physico-chemical and performances characteristics of cashew nut shell liquid as surface coatings. In *Proceedings of the 26th CAPA International Conference on:"Competency-Based Education and Green Skills for Work and Life in Post-2015 Africa–The Role of TVET, 12*, 70-83).

Ichu, C. B., & Nwakanma, H. O. (2019). Comparative Study of the physicochemical characterization and quality of edible vegetable oils. *International Journal of Research in Informative Science Application & Techniques (IJRISAT)*, *3*(2), 1-9. https://doi.org/10.46828/ijrisat.v3i2.56

Seneviratne, K., & Jayathilaka, N. (2016). Coconut oil: chemistry and nutrition. *Battaramulla: Lakva Publishers*, pp. 1-142.

HOW TO CITE

Apurba Bhunia, Sourav Bar, Sujit Das, Sudipta Kumar Ghorai, Bhanumati Sarkar, Biplab Kumar Behera (2024). Determination of Nutritional Quality Between Indigenous and Imported Cashew Nuts. © International Academic Publishing House (IAPH), Dr. Somnath Das, Dr. Latoya Appleton, Dr. Jayanta Kumar Das, Madhumita Das (eds.), Life as Basic Science: An Overview and Prospects for the Future Volume: 2, pp. 35-43. ISBN: 978-81-969828-6-7 doi: https://doi.org/10.52756/lbsopf.2024.e02.002