The Pharma Innovation Journal 2022; 11(3): 2020-2023

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; 11(3): 2020-2023

www.thepharmajournal.com
Received: 16-12-2021
Accepted: 28-01-2022

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Quality analysis of solvent extracted *Heijuga* wild walnut oil of Manipur, India

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Abstract
Wild walnut (*Juglans regia* L.) *Heijuga*, grown spontaneously in the forest of Manipur and Himalayan ranges, India, underutilised. Crop that produce oil are essential for agricultural sector's economic growth. In this study solvent extraction method was adopted for the extraction of *Heijuga*, Wild walnut oil of Manipur. It was studied that the oil contents of *Heijuga* an average of 64.01%.

Keywords: Analysis, solvent, *Heijuga*, *Juglans regia* L.

Introduction
Heijuga, also known as wild walnut (*Juglans regia* L.), is a Juglandaceae tree with a greenish-moderate husk as well as a brown, ribbed nut that grows naturally in the forests of Manipur, India. Rising food supplies alone will not be enough to sustain the growing global population. Several crops were ignored to the point where biological degradation became serious. Plants that have yet to be discovered have the capacity to resolve more severe productivity and consumption limits. Numerous species have the ability to add to food and nutrition security, health, dietary and culinary diversity, as well as health and revenue.
Plants that produce oil crops are important for the agricultural sector's economic and social development. Rural poor in Manipur pick wild walnuts and sell them as a source of income in the local market. This is also a viable option for those who can't actually afford a commonly available, grown walnut variety. The use of wild walnuts is limited. Manipur's wild walnut, *Heijuga*, will contribute as a rich source of crop yielding oil.
Wild walnut is an underused crop in Manipur, India. Its valuation will rise as a result of its application in the extraction of oil. The purpose of the research was to find out more about the quality of Manipur's solvent-extracted *Heijuga* (wild walnut) oil.

Materials and Methods
All the preliminary and final experiments have been conducted in research labs of the Department of Food Process Engineering, SHUATS. Few experiments at Food Analytical and Research Laboratory (FARL), University of Allahabad, Uttar Pradesh (India). Food Analysis & Research Laboratory (FARL) has reached a key milestone in the University's history by receiving NABL accreditation for chemical and biological testing of food and water on July 9, 2013. In Northern India, Allahabad University's FARL has become the only NABL-accredited laboratory.
The proximate composition of raw wild walnut oil was determined, moisture content (%), fat (%) and ash content (%). Physical parameters of crude wild walnut oil such as specific gravity and refractive index were also measured. Chemical parameters of crude wild walnut oil including free fatty acid content (percentage), iodine value, saponification value, peroxide value (Meq/kg), phosphorus (mg/100g), colour (L,A,B) and acid value (mg KOH/ g) were studied.

Selection of raw material
The wild walnut (*Heijuga*) was obtained from the regional market of Imphal, Manipur, (India). For extraction of crude wild walnut oil, the wild walnut is cracked with the help of walnut cracking mill and the walnut kernel was separated manually. Crude wild walnut oil was extracted using soxhlet apparatus, solvent extraction.

Chemicals, glassware and equipment

All chemicals, used during the investigation, were AR grade and purchased from the standard suppliers. The borosil made glassware were used during the study. All glass wares were cleaned, washed and dried before use. The equipment used in the study is given in Table 1.

Table 1: List of equipment with their specifications and purpose

S. No.	Equipment/Instruments	Specifications	Purpose
1.	Walnut cracking mill	Developed by SHUATS, Prayagraj	Cracking of *Heijuga*, wild walnut
2.	Soxhlet apparatus	Made by Popular India	Solvent extraction of wild walnut oil
3.	Analytical balance	A & D Orion series,	Weighing the chemicals and sample
4.	Hot air- oven	Microtech Medcraft	Moisture content determination of *Heijuga*, wild walnut oil
5.	Refractometer	Hand refractometer	Refractive index determination of *Heijuga*, wild walnut oil
6.	Spectrophotometer	Range: 340 to 960 nm, Grating 600 lines/mm, Power: 230 V, 50 Hz	Phosphorus determination of *Heijuga*, wild walnut oil
7.	Muffle furnace	Yorco sales Pvt. Ltd., Model HMF	Ashing of *Heijuga*, wild walnut oil

Sample and crude wild walnut oil preparation

Wild walnuts contain tougher shells which are more difficult to break as compared to the other commercial walnut. Commercially available walnut is easily broken with a nutcracker. But wild walnut is not broken with the nutcracker, but breaks with the help of the hammer. Wild walnuts have many efforts to break this into the two halves by the hammer. Wild walnut was broken up in walnut cracking mill (Make: Department of Food Process Engineering, SHUATS, Prayagraj). The kernel was separated from broken walnut. The obtained walnut kernel was then kept in glass containers until further processing. The process for obtaining wild walnut kernel is shown in Fig 1.

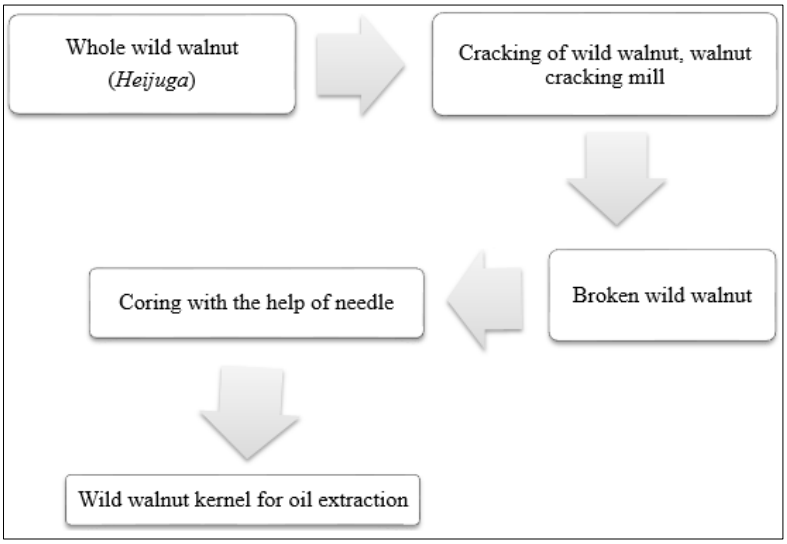

Fig 1: Method for preparation of wild walnut kernel for oil extraction

Extraction of wild walnut oil by soxhlet apparatus

For oil extraction, petroleum ether was utilised as a solvent. from wild walnut kernel. The process flowchart for solvent extraction of oil from the wild walnut kernel is shown in Fig. 2 Extraction of oil was carried out by the method summarized by Asha Srinivasan, *et al*. (2008) [3]. The extract was concentrated under reduced under hot air oven. The extracted oil obtained is crude wild walnut oil and stored in a dark place at room temperature.

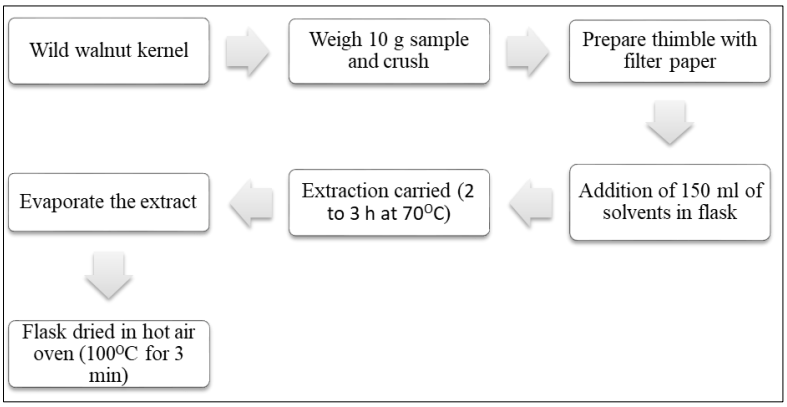

Fig 2: Extraction process flowchart of crude wild walnut oil

Analysis of quantitative and qualitative parameters of crude and refined wild walnut oil

The experiments for quality analysis were conducted based on standard methods by AOAC, official methods and FSSAI manual 2 for oil and oilseeds. The moisture content was calculated by Air-Oven Method, FSSAI Lab Manual 2(3.0). Specific gravity was determined by AOAC 17th edn, Official method 920.212 (2000). Refractive index was determined by AOAC 17th edn, Official method 921.08 (2000). Saponification value is the number of mg of potassium hydroxide required to saponify 1 gram of oil/fat. Determined by AOAC 17th edn, Official method 920.160 (2000). ISI. Handbook of Food Analysis (Part XIII)-1984 Page 67/ IUPAC 2.201(1979) / IS: 548 (Part 1) – 1964 (Re: March 2011) was used for determination of acid value. Iodine value was determined by AOAC 19th Ed (2012) Method 993.20. Colour was measured by X-Rite colour method. The determination of phosphorus content was spectrophotometer/ PORIM Test Methods (1995). ISI. Handbook of Food Analysis (Part XIII)-1984 Page 67/ IUPAC 2.201(1979) / IS: 548 (Part 1) – 1964 (Re: March 2011) was used for determination of free fatty acid. Peroxide value was determined by IS: 548 (Part 1) – 1964 (Re: March 2011).

Results and Discussion

The results collected for every factor and their link to one another have been discussed. Three replications of parameters studied were made and consequently averaged and tabulated.

Quality of crude wild walnut oil

The quality of raw wild walnut is of considerable significance as it is directly correlated with processing or otherwise storage stability. This is because refiners are bound to comply with strict requirements. Crude oil should preferably be quickly processed with excellent oxidative and color stability, and also treated at the lowest cost of refining.

Crude wild walnut oil was extracted using a solvent extraction technique. In general, the close composition describes the health and the final product nutrition quality. In order to determine the impact on final product, it is necessary to evaluate the proximate composition of wild walnut oil. The proximate composition of raw wild walnut oil was determined and referred to in Table 2

Table 2: Proximate constituents of crude wild walnut oil

Parameters	Mean Value
Moisture (%)	2.766
Ash (%)	1.866
Total fat (%)	64.80

* Each value is the mean of three observations.

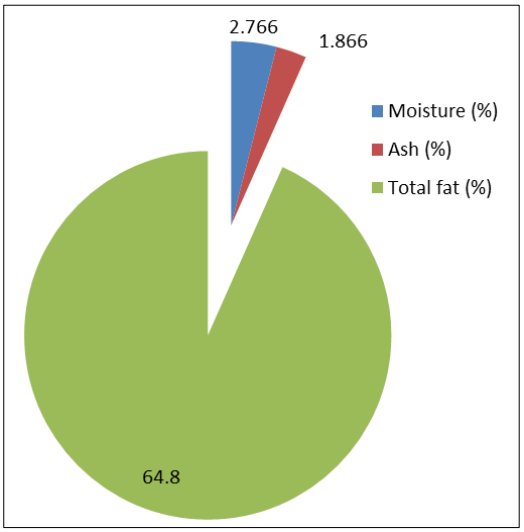

Fig 3: Proximate constituents of crude wild walnut oil

Table 3: Physical parameters of crude wild walnut oil

Physical parameters	Mean Value
Specific gravity	0.98
Refractive index	1.4704

* Each value is the mean of three observations

Table 4: Chemical parameters of crude wild walnut oil

S. No.	Test parameter (s)	Test Method Used	Mean value
1.	Free fatty acid	IS 548 (part-1): 1964 (Re: March 2011)	0.75 (%)
2.	Iodine value	AOAC 19th Ed(2012) Method 993.20	84.86
3.	Moisture	FSSAI Lab Manual 2(3.0)	2.766 (%)
4.	Saponification value	FSSAI Lab Manual 2	163.00
5.	Peroxide value	IS 548 (part-1): 1964 (Re: March 2011)	18.0 meq/kg
6.	Phosphorus	Spectrophotometer	9.99 mg/100g
7.	Colour	X-Rite Colour	L -45; a +3.19; b +41.46
8.	Acid value	IS 548 (part-1): 1964 (Re: March 2011)	0.283 (mg KOH/ g)

* Each value is the mean of three observations.

The data provided in Table 2 defines the composition of the major components of raw wild walnut oil. The moisture content of the sample was found to be 2.766 per cent, while the ash content was found to be 1.866 per cent. The ash content reflects the total amount of minerals and, based on the results obtained, it could be assumed that raw wild walnuts that contain a significant amount of nutrients. The fat content of raw wild walnuts was observed to be 64.80 per cent. Based on the findings experienced, it could be indicated that raw wild walnut appears to contain a considerably higher fat content of 64.80 per cent, which characterises its oil value. The findings of the present research were in close compliance with the amounts stated by Mehnet Musa Ozcan (2009) [9], Cheok *et al*. (2014) [4].

The extracted raw wild walnut oil was analysed for different physicochemical characteristics. The information collected describing the physical parameters are shown in Table 3.

The extracted raw wild walnut oil was yellowish. Mehnet Musa Ozcan (2009) [9] stated that other nut oils, such as pistachio, Brazil nuts, are light in colour. The specific gravity and refractive oil index may be useful in understanding the quality of the oil. It is noted that Specific gravity and raw wild walnut oil refractive index are 0.98 and 1.474, respectively.

Chemical properties are essential for assessing the

acceptability of oil in food. In addition to the quality of the finished products, the chemical properties are also solely accountable for the shelf - life of the oil. Significant chemical properties determining the acceptability of raw wild walnut oil are determined. Details on the chemical properties of crude wild walnut oil are described in Table 4.

Free fatty acid level is indeed a key component in the stability of the storage of oil. The free fatty acid concentration of raw wild walnut oil has been found to be 0.75 (%) during the present study, while the acid value was 0.283 (mg KOH/ g). The importance of iodine suggests the presence of unsaturated fatty acids. Higher iodine value indicated lowers saturation and vice versa. The iodine value for raw wild walnut oil was 84.86. The peroxide value of oil is the degree of oxidative deterioration. Saponification number specifies the features of the fatty acids in the oil, the larger the chain of carbon generally the least acid every gram of hydrolysed oil is produced. The level of saponification for raw wild walnut oil was 163.00. The finding was endorsed by Mehnet Musa Ozcan (2009) [9].

Conclusion

Present study could provide an additional boost to the economic sector through the utilisation of wild walnut (*Heijuga*) of Manipur, India as a source of edible oil. This research has, therefore, been proved to be an efficient approach to refining of wild walnut oil.

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