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Shubham Singh
Student, M. Tech. Agricultural Engineering (Agricultural Process & Food Engineering), Department of Food Process Engineering, SHUATS, Prayagraj, Uttar Pradesh, India

Er. K. Lakshmi Bala
Assistant Professor, Department of Food Process Engineering, SHUATS, Prayagraj, Uttar Pradesh, India

Dr. Shanker Suwan Singh
Assistant Professor, Department of Dairy Engineering, Department of Dairy Engineering, SHUATS, Prayagraj, Uttar Pradesh, India

Er. Ankita Kumari
B. Tech. Food Technology, Department of Food Process Engineering, SHUATS, Prayagraj, Uttar Pradesh, India

Corresponding Author:
Shubham Singh
Student, M. Tech. Agricultural Engineering (Agricultural Process & Food Engineering), Department of Food Process Engineering, SHUATS, Prayagraj, Uttar Pradesh, India

Effect of processing conditions on solvent extraction of Amla (*Emblica officinalis*) seed oil

Shubham Singh, Er. K. Lakshmi Bala, Dr. Shanker Suwan Singh and Er. Ankita Kumari

Abstract
The present investigation, "Effect of processing conditions on solvent extraction of Amla (*Emblica officinalis*) Seed Oil" was undertaken with the objectives to extract oil from Amla seeds at different temperature and time, the effect of temperature and time on yield of Amla seed oil and quality attribute of Amla seed oil at different temperature and time included parameters:- temperature, time, effect on free fatty acid and acid value.

The primary processing of Amla seed before oil extraction include cleaning, cracking and conditioning, these ruptures the oil cells, for efficient extraction. Amla seed oil was extracted using the reagent Petroleum ether in soxhlet method with some of chemical properties for nutritional benefits. The extracted oil had higher yield of 14% at 70 ^{0}C in 3.5 hours due to which it could reduces the time and processing of amla seed which decreases the pollution and does not affect the environment. The Free Fatty acid of the amla seed oil tested at different stages was ranges from 21 to 24% and acid value was ranges from 22 to 25 mg/KOH/g. In general the Free Fatty Acid and Acid value is decreases with increase in temperature and time. Although our research shows the change in the chemical characteristics with increase in temperature is low, the rate of change must be monitored because of the likely deterioration of the overall quality of the oil at elevated temperatures.

Keywords: Amla, extraction, temperature, time, amla seed oil, effect, yield, free fatty acid, acid value

Introduction
It is commonly grown in India, particularly in the Uttar Pradesh districts of Pratapgarh, Rai Bareilly, Varanasi, Jaunpur, Sultanpur, Kanpur, Agra and Mathura. The extensive planting takes place in the salt-affected areas of Uttar Pradesh state, including ravenous areas in Agra, Mathura, Etawah, Fatehpur and Bundelkhand's semi-arid tract. Amla cultivation is also spreading rapidly in the semi-arid regions of Maharashtra, Gujarat, Rajasthan, Andhra Pradesh, Karnataka, Tamil Nadu, Aravali ranges in Haryana and Kandi area in Punjab and Himachal Pradesh. This is the second highest among all the cultivated fruits. Owing to hardy nature, suitability to various lands, high productivity area (15-20 tons/ha). In (2018-19) Amla gooseberry production and region in India was 1098 mt in the first estimate within the area of 94 ha. In (2017-18) amla gooseberry production and region in Uttar Pradesh-production within 33.70 ha was 285.40 mt. In (2017-18) production and area of Amla all over the India was 1092 mt in the 1st estimation with in the area 87 ha and 980 mt in 2nd estimation within the area 89 ha and similarly 1030 mt in the 3rd estimation within the area 94 ha. In (2016-17) production and area of amla/gooseberry in Uttar Pradesh production was 280.70 mt within the area 34.90 ha.

Objectives
1. To extract oil from Amla seed at different temperature and time.
2. To study the effect of temperature and time on yield (%) of Amla seed oil.
3. To study the effect of temperature and time on quality attribute of Amla seed oil.

Materials and Methods
Extraction of oil was carried out by the method summarized by Asha Srinivasan, *et al*. (2008) [6]. In order to get maximum yield of oil, the seeds were extracted for different periods of time and other parameters *viz.* amount of amla seeds (10g) and quantity of solvent (150 ml) are kept constant. 10 g of seeds were crushed and extracted with Petroleum ether (60-80) ^{0}C LR for different temperature and time in Soxhlet apparatus.

The extract was concentrated under reduced under rotary evaporator. The extracted oil was stored in dark place at room temperature.

Free Fatty Acid (%)

The free fatty acid in oil is estimated by titrating it against NaOH in presence of phenolphthalein indicator. The Free Fatty acids are expressed as oleic equivalents. 1–10 (g) of oil was dissolved in 50 ml ethanol (ethyl alcohol) in a 250 ml conical flask. Few drops of Phenolphthalein were added. The content was titrated against 0.1N sodium hydroxide. The flask was shaken constantly until a pink color which persists for 15 sec is obtained.

Acid Value (mg/KOH/g)

50 ml of ethanol was in a 250ml flask. Add 1-10 (g) of oil in a 250 ml conical flask and few drops of phenolphthalein were added to the mixture. The mixture was titrated with 0.1 N KOH to the end point with consistent shaking for which a dark pink colour was observed and the volume of 0.1 N KOH (V_0) was noted.

Results and Discussion

Table 1: Effect of Temperature and Time on Yield (%) of Amla seed oil

Std	Run	Temp (^{0}C)	Time(hour)	Yield (%)
8	E1	70	3.5	14
7	E2	70	0.6	07
6	E3	84	2	13
2	E4	80	1	09
5	E5	56	2	07
4	E6	80	3	14
3	E7	60	3	09
1	E8	60	1	07

It was found that the length of application and amla seed oil temperature have a linear relationship with the oil yield for temperature below 70 ^{0}C (Miwithiga and Moriasi, 2007) [23]. Nevertheless, the oil yield fell by 9-14 percent at 70-84 ^{0}C. Such findings are consistent with those reported as it was clarified that it would be at high temperature to reduce the oil yield. An increase in temperature decreased the kinematic viscosity of the oil with improved biopolymer mobility in cell walls (Lawson *et al.*, 2010) [31]. The yield has been significantly decreased to 13%, at the extraction period of 2 hour and temperature 84 ^{0}C and 14% at the extraction period of 3.5 hour and temperature 70 ^{0}C. On the basis of obtained results, extraction period of 3.5 hour and temperature 70 ^{0}C could be considered optimum for the extraction of maximum Amla seed oil.

Table 2: Effect of Temperature and Time on Free Fatty Acid (%) of Amla seed oil

Std	Run	Temp (^{0}C)	Time (hour)	Free Fatty Acid (%)
8	E1	70	3.5	23.4
7	E2	70	0.6	22
6	E3	84	2	23.6
2	E4	80	1	23.1
5	E5	56	2	22.8
4	E6	80	3	24
3	E7	60	3	23
1	E8	60	1	22.4

The hydrolysis of oils and fats produces free fatty acids. The FFA level depends on the content of time, temperature and humidity because the oil and fats are exposed to different conditions such as storage, refining and heating. Since FFA is less stable than neutral oil, it is more likely to oxidize and become rancid (S.A. Mahesar *et al*., 2014). Temperature has been recognized as one of the factors that reduce oil quality (Jabeur *et al*., 2015; Santos *et al.*, 2013) [20, 14]. The presence of Free Fatty Acids value is always an important factor signifying the quality and storability of oils. During present investigation, Free Fatty Acid content of Amla seed was observed to be 23.4%.

Table 3: Acid Value (mg/KOH/g) of Amla seed oil at different extraction period

Std	Run	Temp (^{0}C)	Time (hour)	Acid Value (mg/KOH/g)
8	E1	70	3.5	24.50
7	E2	70	0.6	23.10
6	E3	84	2	24.99
2	E4	80	1	24.75
5	E5	56	2	23.40
4	E6	80	3	24.90
3	E7	60	3	23.50
1	E8	60	1	23.00

Acid quality shows the suitability of oil for personal use and industrial use (Al-Bachir, 2015) [9]. Increased acid quality can be induced by elevated temperature, oil moisture and, most importantly, origin lipases or contaminating microorganisms (Atinafu and Bedemo, 2011) [13]. The presence of acid value is always in important factor signifying the quality of oils. During present investigation, acid value content of Amla seed was observed to be 24.50 mg/KOH/g (FSSAI- 2011) [18].

Conclusion

The oil-containing Amla seed was extracted using petroleum ether reagent (60-80) ^{0}C LR from amla seed. Eight trails were used to test the yield of amla seed oil, during which petroleum ether trials in soxhlet extracted the oil from the sample. With the running time, oil yield increased to 14 percent. It could be concluded that the extraction period of 3.5 hour and temperature 70 ^{0}C could be considered optimum for the extraction of maximum Amla seed oil. Amla seed oil was analyzed for different temperature and time including having Free Fatty Acid 23% and Acid value 24.50 mg/KOH/g, which directly affects the quality of the oil. The amount of Free Fatty Acid and Acid Quality depends on time and temperature because the oils and fats are exposed to different conditions including storage, refining and heating. Free fatty acid and acid quality in oil are less stable, so they are more likely to oxidize and cause rancidity. Free fatty acid and acid content are therefore a key characteristic of the quality and value of oils and fats.

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