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Extraction and characterization of papaya seed oil

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ABSTRACT

The papaya seed oil was extracted by solvent extraction method. The characteristic of seed oil was studied. Percent seed oil was recorded 30.1 and chemical composition of papaya seed was found to be protein (28.1%), Ash (8.2%), Crude fiber (19.1%) and total carbohydrate (25.6%).The papaya seed oil consists of iodine value (65.5), saponification value (155.5), unsaponifiable matter (1.37%) and free fatty acid (0.32%).The major fatty acid of papaya seed oil were oleic acid(72.5%) followed by palmitic acid (13.5%) and stearic acid (4.5%). Thus it can be concluded that the seed can be utilized for extraction of oil which has various health benefits with respect to essential fatty acids.

Introduction

Papaya (*Carica papaya* L.) is a plant that grows wild in many parts of the tropics. The seeds of papaya fruits are generally discarded. However, in order to make a more efficient use of papaya, it is worth investigating the use of the seeds as a source of oil. A compound present in crushed papaya seed that is believed to have activity against helminthes intestinal parasites, benzyl isothiocynate, has been shown to have an effect on vascular contraction using a canine carotid artery in vitro model (Wilson and Kwan, 2002). Papaya seed oil utilized in high amount such oils could lead to reduced risk of coronary heart disease. In addition, high oleic oil has sufficiently stability be used in demanding application such as frying. Area of spray oil for snacks, crackers, cereal dried fruit, bakery products where the oil is used to maintain product quality and to increase palatability. Papaya seed oil can be considered as high oleic oil and hence viewed as a healthy alternative to many other vegetable oils (Corbett, *et al* 2003).

The extraction and use of vegetable oils has for centuries played an important role in the manufacture of a large number of industrial products and food items. Currently, two main processes for the extraction of oil from seeds are of industrial importance: the hydraulic process and further purification and the chemical process using organic solvents (McGlone *et al.* 1986). This latter process for extracting oil from seeds, although giving high oil extraction recovery, requires expensive capital investment and operational costs and causes undesirable effects on the quality of end products because of the high temperatures used in the process (Christensen, *et al*, 1991). There is also an older process of aqueous extraction that is advantageous, because it presents no risk of fire or explosion, is nontoxic and the mild processing ensures high quality products (Dominguez *et al.* 1995). The operation is also more flexible with less initial investment and operational costs. The main disadvantages, as compared to conventional technologies, are lower efficiency of oil extraction and the reduction of product stability, leading to easier microbial contamination. Aqueous extraction, on the other hand, yields not more than 35% of the oil content of the seed (Tano-Debrah and Ohta 1994).

Considering their widespread applications, these processes thus contribute to major losses of fats and oils in the world's food production system. This is an issue worth considering as efforts are intensified to increase fat and oil production to meet the quickly growing global demands (Tano-Debrah and Ohta 1995a). With rising value for oils and with demands for better oil quality, coupled with several years of unfavorable climate conditions in growing regions, there has been a noticeable increase in trials using enzymes for processing a wide variety of oil sources including palm, olive, soybean, rapeseed, sunflower seed, cottonseed, corn germ and groundnut (Godfrey and Reichelt 1983). The use of enzymes shows some improvement in the yield of oil, together with a reduction in the acid development and oxidation of the oil during further processing and storage. Also, there is a reduction in undesirable side products and in waste treatment costs (Dominguez *et al.* 1994). Much research has been done on enzyme-assisted oil extraction from various seeds such as sunflower kernel (Dominguez *et al.* 1995), shea tree (Tano-Debrah and Ohta 1994, 1995a), canola, cocoa beans (Tano-Debrah and Ohta 1995b) and coconut (McGlone *et al.* 1986; Tano-Debrah and Ohta 1997). The enzymes used in the extraction 64 T. The process that were most frequently referred to in the literature are protease, a amylase, cellulose and pectinase. However, there is no literature on the extraction of oil from papaya seeds using the enzymatic process, even though these seeds have proven to be valuable sources of usable oil (Harvey *et al.* 1978). Thus, the aim of this work is to determine and to compare the physicochemical properties and the quality of oil extracted from papaya seeds using different enzymes with that of oil extracted using solvents.

Material and Methods

Papaya fruit

Whole papaya fruits were procured from local market of Parbhani. Most of the chemicals used in this investigation were of analytical grade. They were obtained from Department of

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Food Chemistry and Nutrition, College of Food Technology, MAU, Parbhani. The equipments were obtained from Department of Food Chemistry and Nutrition, College of Food Technology, MAU, Parbhani.

Pretreatment of Fruits

Procured Papaya were washed, wiped and then stored at 10^0C in the cold chamber.

Preparation of essential oil

For solvent extraction, 150 g of ground seeds were placed in a cellulose paper cone and extracted using light petroleum ether (BP 40–60C) in a 5-L Soxhlet extractor for 8 h (AOAC 1984). The oil was recovered by evaporating the solvent using a rotary evaporator Model N-1 (Eyela, Tokyo Rikakikai Company, Ltd, Tokyo, Japan) and the residual solvent was removed by drying in an oven at 60C for 1 h and by flushing with 99.9% nitrogen. For aqueous enzyme extraction, 15 g each of ground papaya seeds were weighed into different 250 mL conical flasks and 150 mL of distilled water were added to give a ratio of 1: 10 (w/v), which is considered to be the best ratio for the oil extraction procedure (Dominguez *et al.* 1995). The samples were gently boiled for 5 min and immediately cooled to room temperature in an ice water bath (Tano-Debrah and Ohta 1995b). The suspension (unmodified at pH 5.8) was then mixed with protease at a 2.0% concentration and incubated at 45^C for 24 h with constant shaking at 120 rpm. The above process was repeated using a -amylase, pectinase and cellulose, maintaining the same conditions. The flasks were removed after the incubation process and to each flask; 100 mL of boiling distilled water was added to stop the activities of enzymes. Oil from enzymatic extraction was recovered by centrifugation at 9820 g of the aqueous mixture using a Beckman centrifuge model J2-12M/E (Beckman Instruments, Palo Alto, CA) at 2^0C for 20 min to separate the emulsion from the residue. The emulsion was decanted and boiled gently to dry the water to obtain the oil (Aparna *et al.* 2002). The oil that was obtained was expressed as percent recovery based on the initial yield that was obtained by Soxhlet method and then stored at 2^0C until analyzed.

Flow Sheet-1. Extraction of papaya seed oil

Chemical composition papaya seed

The methods of Pearson (1976) were used to determine the moisture, protein and oil content of seed, while the determination of ash and crude fiber contents was done according to Pomeranz and Meloan (1994). The total carbohydrate was determined by difference. The protein, oil, ash and crude fiber contents were expressed as percent wet weight.

Chemical properties

The determination of peroxide, iodine and saponification values, unsaponifiable matter and free fatty acid (FFA) contents was carried out using the methods of Palm Oil Research Institute of Malaysia. (PORIM 1995).

Saponification value:

Accurately weigh out 2 g of oil into a 250ml of conical flask, add 25ml of alcoholic KOH and dissolve the oil completely. Connect air condenser to the flask and boil for about 30 min on a boiling water bath. Cool to room temperature; add 2 drops of phenolphthalein indicator and mix. Titrate against standard 0.5 N HCl until the pink colour disappears. Treat blank similarly in absence of oil.

$$\text{Saponification value} = \frac{(\text{Blank} + \text{Titre}) \times 100}{\text{Weight of oil}}$$

Iodine value:

Weight out 0.2g of oil into 500 ml conical flask. Add 20 ml of chloroform and dissolve the oil completely. Keep in dark for 30 min. Add 20 ml of KI solution and mix well. Titrate against 0.1 N $Na_2s_2O_3$ solution using starch as an indicator with vigorous shaking to extract iodine from the chloroform layer. Conduct blank similarly in absence of oil.

$$\text{Iodine number} = \frac{A \times N \times 0.1269 \times 100}{\text{Weight of oil}}$$

Where, A= ml of $Na_2S_2O_3$

N=Normality of $Na_2S_2O_3$

Free fatty acid content:

The free fatty acid in oil is estimated by titrating it against KOH in presence of phenolphthalein indicator. The acid number is defined in 1 g of sample. However, the free fatty acid is expressed as oleic equivalents. 1 ml N/10 KOH= 0.028g Oleic acid.

Physical properties of essential oil

Yield

Calculate wt of derived oil from wt of peel taken.

$$\text{Yield \%} = \frac{\text{Wt of oil}}{\text{Wt of Sample}} * 100$$

Appearance & odour

The appearance and odor are evaluated from semi-trained panel.

Results Discussion

In the present investigation the papaya seeds were analyzed for its chemical composition and average values were tabulated in table1

Chemical composition of carica papaya L. (carica) seeds as percent wet weight

It is seen from table no 1 that the seed contained moisture (7.3%), oil (30.9%), protein (28.1%), ash (8.2%), carbohydrate (25.6%), and crude fibre (19.1%). The result of the present investigation are more or loss similar to that of Marfo *et al.*, (1986) and Pungasari *et al* (2004).

Characteristics of papaya seed oil by (solvent extraction)

The chemical properties are the most important characteristics of oil, the FFA and iodine value is measure of the degree of unsaturation of the oil. The data pertaining to the Characteristics of papaya seed oil is reported in table 2. It is observed from the table 5 that papaya seed oil consist of iodine value (65.5), saponification value (155.50), % Unsaponifiable matter (1.37%), and FFA (as % of oleic acid) 0.32. The Characteristics of papaya seed oil are in close agreement with that of Pungasari *et al*, (2004).

Fatty acid composition (%) of papaya seed oil

The fatty acid composition of papaya seed oil is shown in table 3. The result showed that the major fatty acid, the relevant extracted oil were oleic (72.5%) followed by Palmitic (13.5%), stearic acid (4.5%) and Linoleic (2.9%). The results of present investigation are well comparable with the result reported by Pungasari *et al*, (2004).

Conclusion

Percent seed oil was recorded 30.1 and chemical composition of papaya seed was found to be protein (28.1%), Ash (8.2%), Crude fiber (19.1%) and total carbohydrate (25.6%).The papaya seed oil consists of iodine value (65.5), saponification value (155.5), unsaponifiable matter (1.37%) and free fatty acid (0.32%).The major fatty acid of papaya seed oil were oleic acid(72.5%) followed by palmitic acid (13.5%) and stearic acid (4.5%).

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Table 1:- Chemical composition of carica papaya L. (carica) seeds as percent wet weight

Sr.No.	Proximate composition (%)	Determined values*
1	Moisture	7.3
2	Oil	30.1
3	Protein	28.1
4	Ash	8.2
5	Crude fiber	19.1
6	Total carbohydrate	25.6

* mean of triplicate determination.

Table 2:- Characteristics of papaya seed oil by (solvent extraction)

Sr.No.	Chemical properties	Determined values*
1	Iodine value	65.50
2	Saponification value	155.50
3	Unsaponifiable matter (%)	1.370
4	FFA (as percentage oleic acid)	0.32

* mean of triplicate determination

Table 3:- Relative fatty acid composition (%) of papaya seed oil

Sr.No.	Fatty acid	Determined values*
1	Myristic (C_{14-0})	0.24
2	Palmitic (C_{16-0})	13.5
3	Palmitoleic (C_{16-1})	0.21
4	Stearic (C_{18-0})	4.5
5	Oleic (C_{18-1})	72.5
6	Linoleic (C_{18-2})	2.90
7	Linolenic (C_{18-3})	0.23
8	Arachidic (C_{20-0})	0.39
9	Eicosenoic (C_{20-1})	0.28

* mean of triplicate determination