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FATTY ACID ANALYSIS OF FAVA BEAN SEED OIL OF DISTRICT KECH, BALOCHISTAN, PAKISTAN FOR ITS VALUATION AS FOOD OR FEED INGREDIENT

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Abstract

The present study was designed to evaluate the fatty acid content of fava bean seed grown in district Kech, Balochistan, Pakistan, for the first time. The crop is mainly found in Balochistan, the largest province of Pakistan and widely consumed as a traditional meal by local communities in the region. The purpose to study fava bean seed was to demonstrate its nutritional and medicinal potency. Fava bean is known as a versatile and a major crop which holds a promising future for mankind but unfortunately this beneficiary legume has not yet cultivated in a proper way in many parts of the world including Pakistan so far. GC-MS method was done to determine the fatty acid composition of fava bean seed oil, results were found to have higher percentage of polyunsaturated fatty acids. The most abundant fatty acids found in fava bean oil are polyunsaturated fatty acids which include linoleic acid, oleic acid and linolenic acid. The linoleic acid was found in highest percentage as 42.50% followed by oleic acid as 25.35% and linolenic acid as 20.05%, while results also confirmed the presence of saturated fatty acids i.e., palmitic acid and stearic acids with concentration up to 17.33% and 5.5% respectively. It is concluded by the result that fava bean seed oil is an excellent nutrient due to its potency and idyllic diet and could be a good candidate for certain applications in food industry and pharmaceuticals.

Keywords: Fava beans, Food industry, Linoleic acid, Linolenic acid, Oleic acid, Palmitic acid, Pharmaceuticals, Stearic acid,

INTRODUCTION

Fava bean (*Vicia faba* L.) is one of the popular legumes in the world which belongs to the family of Fabaceae. Seeds of legume plants are well known to be a source of nutritious ingredients such as carbohydrates, proteins, lipids, fatty acids, minerals, and vitamins (1). Legumes are believed to have the supportive role in the production of proteins by the replacement of meat and dairy products. Among the legume's fava bean is a most versatile and valuable as it is the great source of protein, fiber, and certain bioactive molecules (2). The Fava bean (*Vicia faba* L.) has a high nutritional value as it is rich in carbohydrates, proteins, vitamins, antioxidants, lipids, fibers, and minerals. The presence of all these essential nutrients makes fava beans an idyllic diet for livelihood.

People of China use Fava beans as food for 5,000 years and Egyptians cultivated those 3,000 years ago. Fava beans grow well and best in moist condition, under cool hence early planting is essential for them. Fava beans consider an annual bean so, hot, and dry climate is not suitable for this annual bean. 650 to 1000 mm of rainfall per year is best for fava bean (2).

Fava bean has four significant groups including Broad bean (*v.faba/major*) eaten as vegetable having long cases with up to 8 seeds for each unit and with short cases called "Windsor" having 4 cases for every seed, horse bean (*v.equine*) for human feed, spasm bean (*v. minor* or little) and *v.paucijuga* like little bean are developed in Central Asia, being not the same as different assortments they are essentially self-pollinating (3).

Pakistan has blessed with rich floral diversity and the variety of legumes which holds a countless advantage in nutritional and pharmaceutical aspects, which can also upgrade the economics of the country but unfortunately, very less work is done on these beneficiary legumes (4). The broad beans with so many benefits have not yet been cultivated in a proper way in the country, which already is under development and deprived of nutritive vegetables.



As far as the occurrence of fava bean is concerned, it is found in Khyber Pakhtunkhwa and Balochistan. Balochistan is the largest province of Pakistan and Fava bean is mainly found in coastal areas of Balochistan (5), Where it is cultivated in the season of winter and grown in heavy clay soils, unlike dry conditions. Fava bean is the well-known vegetable of district Kech of Makran division in Balochistan hence production of fava bean occurs on large scale by these areas and the pods and seeds of fava beans are used as a traditional meal by people of Makran. It is a good source of livelihood for them.

Along with the other crucial nutritive components, the fava bean also contains a wide variety of fatty acids, as they are widespread in nature (6). Fatty acids are the major constituents of various lipids and the chief source of concentrated storage form of energy (7). The metabolism of fatty acids produces the large number of adenosine triphosphate (8). Human body can synthesize several fatty acids except the fatty acids with odd number of carbons (9).

Unlike animals, the biosynthesis of fatty acids in plants occurs in chloroplasts and plastids. Plants are the chief source of some essential fatty acids such as linoleic acid and the α -linolenic acid. A huge variety of fatty acids is synthesized by plants among them the palmitic, oleic, linoleic, and linolenic acids have found to be the utmost important for man as well as animal (10).

Fatty acids served as the reserved fuel in body. The membrane permeability as well as the formation of membrane is regulated by them. Fatty acids can be found in two different forms such as, saturated (with single bond) and unsaturated (with double bonds) fatty acids. Fatty acids have one double bond, and more than one double bond are known as monounsaturated and polyunsaturated fatty acids, respectively (11).

Due to its numerous health benefits, omega-3 fatty acids (essential fatty acids) have been demonstrated to be extremely important for human health. Because the human body is unable to generate these essential fatty acids, they must be obtained through diet. These are necessary for skin and hair growth, as well as for the body's proper visual, neurological, and reproductive functioning. These fatty acids have been shown to be extremely beneficial (12).

Dietary fatty acids can have an impact on people's health, and they can worsen or improve the progression of certain diseases. Scientists are attempting to find biomarkers for various diseases to track their progression, distinguish between those with similar symptoms, and provide an accurate diagnosis (13).

The main purpose of this study is to investigate the fatty acid composition of fava bean seed oil by the GC-MS technique. This study can provide crucial standards for the evaluation of fava bean seed quality in terms of its applications in food industry as a valuable source of vegetable oil.

METHODOLOGY

SAMPLE STORAGE

Fava beans usually arise in hot climatic region of Pakistan; the Makran division is one of the warmest climatic zones of Pakistan (14) thus fava beans are present there in large number. Seeds of fava beans were collected from the fields of District Kech during summer.

The beans were washed with deionized water and kept in sheltered area for 10 days to shade dry. Dried beans were grinded in an electrical mini corn milling grinder (model M6FFC-160 China) to make fine and granular powder then stored in polyethylene bags for further analysis.

OIL PREPARATION

50 gm of ground fava beans was put into thimble of Soxhlet apparatus, standard procedure was adopted for the extraction of oil from fava beans using Soxhlet apparatus as described by (15). Continued the extraction process for 6 hours. Removed the condensing unit from extraction unit and allowed the sample to cool down. Collected almost all the solvent after distillation and stored the extraction in airtight bottles for further analysis. Whole process was carried out in standard pressure and temperature.

Preparation of fatty acid methyl esters (FAME) in following steps:

For the preparation of FAME, the following steps were followed as described by (22).

1. In a test tube, 1 ml of oil sample was mixed with 0.2 ml internal standard and 15 ml of 0.5 N methanolic NaOH.
2. The test tube was then placed into the water bath for 30 minutes; the temperature of water bath was set at 80°C for 30 minutes.
3. In a second test tube 4 ml of same solution (mentioned above) was taken and 5ml of BF₃ (Boron trifluoride) in methanol was added into it and placed it in water bath as well.
4. After heating, both the solutions were cooled down at room temperature.
5. Then added 5ml of saturated NaCl and centrifuged them.

6. Same process was repeated with 2 ml of hexane, just a little amount of anhydrous sodium sulphate was added to the hexane extract for the removal of water content.

DETERMINATION OF FATTY ACID METHYL ESTERS (FAME)

After the FAME preparations, its analyzation was done by GC-MS. First, the adjustment of oven temperature was done in following manner:

At first the oven temperature was set at 84°C for 4 minutes. Then the temperature was raised up to 175°C at a rate of 15°C /min for 15 minutes. Again, raised the temperature up to 220°C at a rate of 25°C/min for 25 minutes followed by 240°C at a rate of 4°C /min for 10 minutes. The temperature of injector then set at 220°C and column at 140°C. Nitrogen was used as a carrier gas at flow rate of 40 ml/min. 0.1-0.2uL hexane solution injected into GC fitted with flame ionization detector to obtain the peaks and standard. Then compared their retention time with standards for identification (23).

RESULTS

The GC-MS analysis for the fatty acid composition of fava bean seed oil was carried out in present study. The obtained results revealed the presence of relatively high percentage of linoleic acid (42.50%), followed by oleic acid (25.35%), linolenic acid (20.05%), palmitic acid (17.33%) and stearic acid (5.5%) as shown in Table I and Figure I. Among these fatty acids, oleic acid, linoleic acid and linolenic acid are polyunsaturated fatty acids which are major constituent for cell membrane fluidity.

DISCUSSION

The quantity and type of fatty acids in oils play a vital role for the determination of their physio-chemical properties and nutritional profile (17). The presence of polyunsaturated fatty acids in high percentage indicates the greater fluidity of plasma membrane (17). The value was compared to the results reported by Khalil et al., 2017 (18). Polyunsaturated fatty acids being essential are utmost important and their deficiency may result in several diseases such as loss of hair, poor wound healing and phrynoderma also known as toad skin (19, 20), which proves its importance in medicinal field as well.

Despite of its beneficiaries, many studies revealed that, an unsaturated double bond is not always found to be good, as it can give rise to the membrane susceptibility to peroxidation, hence upgrade the level of oxidative stress (21).

Generally, the oil contains high content of polyunsaturated fatty acids have found to be good in taste as well as better stability of frying, in addition the linoleic acid has a key role to nourish the skin, thus the findings of our results in combination with recent reports indicates that fava beans could be a source of consolidated nutritional ingredients (essential fatty acids, carbohydrates, amino acids, phytochemicals and antioxidants). In addition to its dietary properties, valuation, and analysis of fatty acid compound of fava beans are of utmost important.

CONCLUSION

Fava bean is a sustainable food source, and its fatty acids composition has a great potential in nutritional and efficient properties for food industry. The results we obtained have revealed that fava bean is a good source of essential oil. Hence it offers a complete nutritive food and could be a good candidate for certain applications in food industry e.g., cooking oil. Furthermore, the presence of a noticeable amount of essential fatty acids in fava bean seed oil also makes it a good candidate in the field of pharmaceuticals. Since fava beans are socio-economic legume so it could provide a cheap and easy approach to obtain bioactive molecules, antioxidants and vital fatty acids hence more advance studies should be done to implement the usage of fava beans in food industry and medical sciences.

Table I. Fatty acid profile of fava bean seed oil

Fatty acids	Percentage present
Linoleic acid	42.50%
Oleic acid	25.32%
Linolenic acid	20.05%
Palmitic acid	17.33%
Stearic acid	5.5%

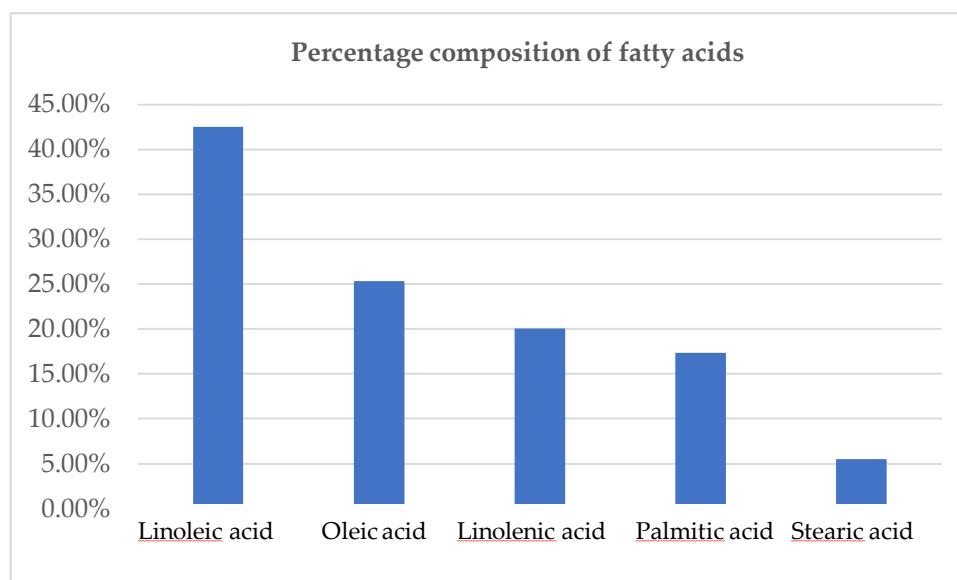


Fig. 1. Fatty acid composition of fava bean seed oil

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