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EVALUATION OF OIL SEEDS FOR THEIR POTENTIAL NUTRIENTS

Muhammad Arif, Nasiruddin, Tariq Masood and Syed Sadaqat Shah
Agricultural Research System, Khyber Pakhtunkhwa, Pakistan
E-Mail: tmafridi@gmail.com

ABSTRACT

Five different oil seed (Mustard, Canola, Corn, Cotton seed and Sunflower) varieties (NIFA raya, Durr-e-NIFA, Jalal, Naib 98 and Gulshan 98, respectively) were analyzed for crude protein, crude oil, and ash contents by chemical methods of AOAC. Total glucosinolate content of mustard and canola samples were determined by Near Infrared Reflectance (NIR) Spectroscopy. Mineral constituents were estimated by Flame Photometer and Spectrophotometer. The data revealed significant ($p \leq 0.05$) variation among the five different oil seed samples in their chemical composition. Cotton highest amount of crude fat was found in mustard seeds (44.67%) followed by canola (43.87%) and smallest amount was recorded for corn (4.23%) followed by cotton (17.83%). Highest crude protein content was found in sunflower (31.57%) while corn contained the lowest concentration of crude protein (12.27%). The ash content was highest in mustard (6.93%) followed by canola (6.73%) while lowest content was found in corn (1.50%). Glucosinolate content of both Brassica varieties tested were less than 30 μM/g, which characterized them as canola type. Mineral concentrations among different oils seeds were also significantly different (($p \leq 0.05$). Sunflower (Gulsahn-98) contained the maximum concentration of phosphorus (0.86%) while maximum concentration of sodium (0.05%) and potassium (0.01%) were found in Corn. sodium and potassium contents in cotton, mustard, canola and sunflower were ranged from 0.003% to 0.05%. It can be concluded that among the oil seed samples analyzed, corn (Jalal) was a good source of minerals while sunflower (Gulshan 98) was a rich source of protein.

Keywords: Oil seeds, nutrients, glucosinolate, Near infra red reflectance spectroscopy, mineral content, NIFA raya.

INTRODUCTION

Seed may be considered a small box containing nutrients for dormant embryo i.e., the miniature plant. These nutrients are also used by animals and humans for their dietary needs. Among all other constituents certain seeds are mainly used for their oil content, which are generally called oil seeds. These seeds are generally produced on annual plants (crops) or large trees like palm, coconut, olive etc. Although the tree seeds contains higher amount of oil but they are very expensive. So the daily dietary requirements of oils could be fulfilled from the various oil seed crops (Gunstone, 2002).

Oils from plant seeds, called vegetable oil, are mostly edible and used in food preparations. Vegetable oils are preferred over the solid animal fats because of health benefits. Oils contain higher proportion of unsaturated fatty acids, while solid fats contain more saturated fatty acids, which increased the low density lipoprotein (LDL) level of the blood, which is considered harmful for human health (Lucas, 2000). Vegetable oils are used as the preferable choice in food preparations. Our farmers grow different oil-seed crops. The oil obtained from these crops contains significant amount of linolenic acid (Khalil and Rahman, 1999).

In Pakistan, various oil seeds used are cotton, sunflower, rape, mustard, canola and corn etc. cotton seed (*Gossypium spp.*) are mainly grown as a fiber crop; however its seeds contain significant amount of oil and are used for edible extraction. Cotton seed oil is locally called "Benola oil" it contains 50% linoleic acid and like corn oil it also supply considerable amount of essential fatty acid in human diet.

Rape seed and mustard are common names used for different species of the family Cruciferae. Rape seed includes *Brassica compestris* (locally called toria, brown or yellow serson) and *B. napus* (locally known as ghobi sarson). Mustard specifically refers to *Brassica juncea* (local name raya) and *Eruca sativa* (local name taramera). These crops have been grown for oil but they consisted of toxic compounds like erucic acid (Figure-1) glucosinolates, (Figure-2) which makes them not suitable for common consumption. The *Brassica* oil-seed crops belong to the family Bracicaceae (synonymous with Cruciferea, common name crucifers) has traditionally attracted the attention of plant breeders and oil chemists, because of its high oil content. These crops, including rape (*B. campestris* L., and *B. napus* L.) and mustard (*B. juncea*) are the third major source of edible oils in the world, after soybean and groundnut (FAO, 1985). The oil content of wild crucifers ranges from about 5 to 50% (Kumar and Tsunoda, 1980; Mikolajezak *et al*., 1961).

The *Brassica* oil-seed crops have been grown in Pakistan since long. The tender leaves of these cultivars serve as vegetable, while the seeds as a source of lubricating and cooking oil. The residue left after oil extraction (i.e., oil cake or meal) being rich in protein (Durrani and Khalil, 1990) can be used as livestock feed (Bell, 1984).

Two main fatty acid patterns have been found in the Crucifera family (Mikolajezak *et al*., 1961; Appelqvist, 1971; Kumar and Tsunoda, 1980). The first one is characterized by linolenic acid ($C_{18:3}$) as the predominant fatty acid. The second pattern shows high levels of erucic acid ($C_{22:1}$). The presence of erucic acid in the *Brassica* species restricted their use as cooking oil (Fenwich *et al*.,

1983) and (Vermoral *et al*., 1988). The erucic acid (mono-unsaturated fatty acid) is toxic. Diet containing erucic acid has shown to be associated with fibrotic changes in the myocardium (Gopalan *et al*., 1974) and (Saur and Kumar, 1983) hence, causes myocarditis and retards growth (Appelqvist and Ohlson, 1972) so it is considered as a health hazard. Likewise, the rape seed meal, inspite of its high protein content, is not considered good as livestock feed due to the presence of glucosinolates, which produce toxic sulphur compounds upon degradation in the intestinal tract of the animals (Khan *et al*., 1984).

The recent introduction of double low (low in both erucic acid and glucosinolate) *Brassica* oilseed cultivars, called canola by Canadian oil Association (CDA) has changed the prospects of *Brassica* oilseed crops worldwide (Kimber, 1984). It is low in both erucic acid and glucosinlolate contents. It contained less than $30\mu Mg^{-1}$ glucosinolate of the deoiled cake (Downey, 1990) and is considered ideal for feed purposes.

Sunflower is an important oil seed crop of the family Compositae. Sunflower oil is comparable to olive oil, it is rich in linoleic acid (essential fatty acid); hence it is a valuable cooking oil (Iqtidar and Amanullah, 2005).

Oil seeds meals are important in animal nutrition as they are used in feed compounds. Oil seed meals are high in protein, with most being over 40% (Young, 1982). They also contain about 10% carbohydrate and some fat (1-6%) depending on oil seed and method used for extraction. Oil seeds and the products made form them, mainly vegetable oils and spreads, have a role in a healthy balanced diet even though they are energy dense and contain a high proportion of fat (Mckevith, 2002).

Oil seeds play a great role in human and animal nutrition. This project is designed to evaluate the most commonly used seeds in Pakistan for oil content, for their nutritional components and anti nutritional factors which have reduced their consumption as oil source.

MATERIAL AND METHODS

In the present study, oil seeds were investigated for their proximate composition, anti nutritional components and mineral profile. Seed samples of the profusely used variety of each sunflower, cotton seed, corn, canola and mustard were collected from Agricultural Research Institute (ARI), Tarnab, Peshawar and Nuclear Institute for Food and Agriculture (NIFA), Peshawar. These varieties were Gulshan 98 (sunflower), Niab 98 (cotton seed), Jalal (corn), *Brassica napus* (Durr-e-NIFA), *Brassica juncea* (NIFA Raya).

Seeds analysis was carried out at Department of Agricultural Chemistry, NWFP Agricultural University, Peshawar, Department of Soil Chemistry, Agricultural Research Institute, Tarnab, (ARI), Peshawar, and Nuclear Institute for Food and Agriculture (NIFA), Tarnab, Peshawar.

The seed of the selected oil crops were hand cleaned and oven dried. The cleaned and dried samples were ground in stainless steel grinder. The ground samples were then stored at 4 ^{o}C in plastic bags for further chemical analysis.

Among the various parameters, glucosinolate and erucic acid content were analyzed by Near Infrared Reflectance Spectroscopy. The whole seed of Mustard and Canola (NIFA raya, Durr-e-NIFA) was placed in a cavutte and analyzed (A.O.A.C, 1990). Crude Protein was determined by Kjeldahl ethod (A.O.A.C, 1990). The conversion factor used to convert Kjeldahl nitrogen to (%) protein was 6.25. Ash content of the dried oil seed samples was determined by straight ash (dry ashing) method (A.O.A.C, 1990). The ground oil seed samples were analyzed for crude oil by Soxhlet apparatus (A.O.A.C, 1990). The samples were acid digested and filtered. Sodium (Na) and Potassium (K) contents were determined by flame photometry. The same filtered samples were further processed for Phosphorus analysis by the SP 3000 UV/VIS Spectrophotometer.

Statistical analysis

Statistical analysis was conducted for each of the measured traits by analysis of variance (ANOVA- using CR design) and the means were separated by LSD as described by Steel and Torrie, (1980).

RESULTS AND DISCUSSIONS

Data regarding proximate composition of different oil seeds is given in Table-1. Data for the mineral content is provided in Table-2. Table-3 contains the Glucosinolate and Erucic content of Mustard and Canola.

Proximate composition

Significant ($P \leq 0.05$) variations were found among the five oil seed samples, with respect to their crude oil content. Highest amount of crude oil was found in *B. juncea* (Durr-e-NIFA) and *B. napus* (NIFA Raya) i.e., 45.67% and 43.87% respectively. Sunflower (Gulshan 98) contained 43.00% while cotton seed (Niab 98) had 17.83% of crude oil. The lowest amount was found in corn (Jalal), i.e., 4.23%. The data was in agreement to those of Rakow *et al*. (1995), Khan *et al*. (1984a).

Like oil the crude protein content of the five oil seed samples was also variable. Significant variations were observed among the five oil seed samples. Sunflower (Gulshan, 98), contained the highest amount of (31.57 %) of crude protein, followed by cotton seed (Niab 98), which had 24.53 % crude protein. No significant difference between *B. juncia* (NIFA-Raya) (23.27%) and *B. napus* (Durr-e-NIFA) (23.33%) was noticed. The least amount of crude protein was found in corn (Jalal), i.e., 12.27%. Same results were reported by Khalil *et al*. (1999).

The ash content was variable among the five oil seed samples. *B. napus* (Durr-e-NIFA) contained the maximum amount of ash (6.93%) followed by *B. juncea* (NIFA-Raya) (6.73%) and sunflower (Gulshan 98), (6.00 %). While cotton seed (Niab, 98) contained (4.56%) and the least amount was found in corn (Jalal), i.e., (1.50%). The results were in agreement to those reported by Besbes *et al.* (2003).

Mineral content

The analysis showed that all the oil seeds contained variable amounts of K, Na and P. These minerals play a major role in structure and function of both plants and animals.

A higher (0.01%) of potassium (K) was found in corn (Jalal) variety while *B. juncia* and *B. napus* contained the next higher same amount of (0.005%) of K. Cotton (Niab 98) contained (0.004%) K, while least amount was determined in sunflower (Gulshan 98), i.e., (0.003%). *B. napus* (Durr-e-NIFA) and sunflower (Gulshan, 98) contained the same high amount of P (0.86%) as compared to other oil seeds. Corn (Jalal) was poorest with respect to its P content (0.53%). Highest amount of Na was estimated in corn (Jalal), while least amount of (0.01%) was found in Sunflower (Gulshan, 98).

Glucosinolates and erucic acid

The specific odour of *Brassica spp*. is due to sulphur containing compounds called glucosinolates (GSL). A maximum 30 µM/g of GSL is accepted in seeds of canola and mustard type canola, *B. napus* and *B. juncia* (Downy, 1990). The GSL content (µM/g) of the two varieties of *Brassica* revealed significant variation (P≤0.05) among the varieties examined. Both of these varieties were found to be low glucosinolate type, which are categorized as canola type.

CONCLUSION AND RECOMMENDATIONS

From the results of the present study, it was concluded that along with oil content the oil seed crops are also a good source of protein, and certain minerals. Among them certain seeds contained erucic acids and glucosinolates which are health hazardous compounds and the seeds cannot be used directly without any treatment in food formulation. Other can be utilized for formulation some of the human balance and process foods and some cane be used as supplements in animal feeds. In the present study the amount of erucic acids were below the permissible limit so canola may be used in this respect.

It was recommended that oil seeds should be analyzed for their other constituents along with oil content. This will prove an economical source for protein, and minerals in food formulation. Some ways and means must be adapted for further biochemical reduction of erucic acids in canola oils.

Table-1. Average values of chemical constituents of oil seeds.

Oil seeds	Variety	Crude Protein (%)	Crude Fat (%)	Ash (%)
Cotton	(Niab 98)	24.53 b*	17.83 b	4.56 c
Sunflower	(Gulshan 98)	31.57 a	43.00 a	6.00 b
B. juncea	(NIFA-Raya)	23.27 c	44.67 a	6.73 a
B. napus	(Durr-e-NIFA)	23.33 c	43.87 a	6.93 a
Corn	(Jalal)	12.27 d	4.23 c	1.50 d
LSD (0.05)		0.17	1.68	0.43

*Average of triplicate data
Means of each parameter followed by common letters in the same column are not significantly different at P≤0.05.

Table-2. Average values of Mineral content of oil seeds.

Treatment	Phosphorus (%)	Sodium (%)	Potassium (%)
Cotton	0.76 a*	0.03 a	0.004 a
Sunflower	0.86 a	0.01 b	0.003 a
B. juncea	0.83 a	0.03 a	0.004 a
B. napus	0.86 a	0.03 a	0.004 a
Corn	0.53 b	0.05 c	0.01 b
LSD (0.05)	0.23	0.02	0.001

*Average of triplicate data
Mean of each parameter followed by common letters in the same column are not significantly different at P≤0.05.

Table-3. Glucosinolates and Erucic acid contents of Brassica varieties.

Oil seeds	Glucosinolate	Erucic acid
Durr-e-NIFA	9.3µM/g	1.3%
NIFA Raya	11.8µM/g	1.8%

*Average of triplicate data

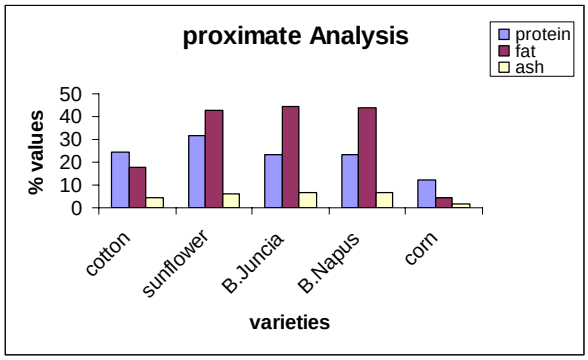

Figure - 1. Proximate composition of five different oil seeds.

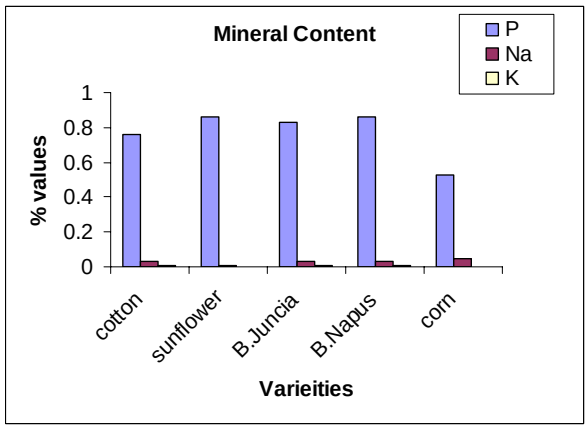

Figure - 2. Mineral composition of five different oil seeds

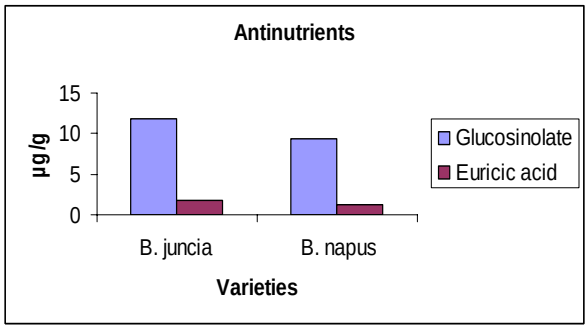

Figure - 3. Glucosinolate and Erucic acid contents of five different oil seeds.

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