

# Experimental study on Grain weight, Moisture, Ash, Carbohydrates, Protein, Oil, Total energy and minerals content of different varieties of Rapeseed and Mustard (*Brassica spp.*)

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**Abstract-** To study the proximate composition of six Bangladesh Agricultural Research Institute (BARI) released varieties of rapeseed (*Brassica campestris* and *Brassica napus*) and mustard (*Brassica juncea*); an experiment was conducted and work was subjected to the comparative evaluation of its physicochemical properties, seed weight, moisture, ash, carbohydrates, protein, fat, total energy and minerals. Among these varieties, the highest grain weight was obtained from BARI Sarisha-13(4.38g) and lowest grain weight obtained from BARI Sarisha-9(3.06g). In case of proximate analysis, the highest protein content and the highest carbohydrate were recorded from BARI Sarisha-15 (28%) and BARI Sarisha-13 (17.02%) respectively. The oil content of different varieties of mustard and rapeseed varied from 38.75% to 42.25%. BARI Sarisha-14(554.3 kcal/g) contained the highest amount of Total Energy. The highest amount of calcium content (2.7%) and the highest amount of Magnesium content (0.739%) were attained from BARI Sarisha-9. Substantial genetic variability exists for chemical composition and nutritional traits which could be utilized to suggest the future strategy for the nutritionist, health advisors and feed manufacturers.

**Index Terms-** Rapeseed and Mustard, Carbohydrates, proximate analysis, Protein, Fats, Energy, Ash and Mineral.

## I. INTRODUCTION

Bangladesh produces good number of oilseed crops like rapeseed and mustard, sesame, groundnut, linseed, safflower, sunflower, soybean, and castor etc of which rapeseed and mustard is considered as the major one (Razzaque *et al.*, 2007). Rape seed and mustard are common names used for different species of the family Cruciferae (Brassicaceae). Rape seed includes *Brassica campestris* and *B. napus*. Mustard specifically refers to *Brassica juncea* and *Eruca sativa*. There are considerable differences in agronomic characteristics, yield, and fatty acid (FA) composition of seed oil between species and between varieties (Bauer, 2015). These crops, including rape (*B. campestris* L., and *B. napus* L.) and mustard (*B. juncea*) are the third major source of edible vegetable oils in the world, after soybean and oily palm (FAO, 2011). 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. It produces 9 kcal energy from 1gm of oil per unit in comparison with other diets (carbohydrate and Protein). In a balanced diet for human health 20-25% of calories should come from fats and oils. The protein quality and quantity of *B. campestris* obtained oil cake is high. (Chowdhury *et al.*, 2014). Mustard is a high yielding oilseed with a reasonably high content of oil (Riley, 2004). Mustard seeds have high energy content, having 28-32% oil with relatively high protein content (28-36%). Until now mustard seeds have been used mainly for condiment production. This advantageous chemical composition and its relatively low price offer wide possibilities for usage of this valuable seed, for example in human foods as additive (Gadei *et al.*, 2012) and to feed animals. Oil is one of the necessary nutrients for the human body, which is supplied by animal and plant sources (Nabipour *et al.*, 2007). Herbal oils are the main sources of fats and fat-soluble vitamins, which have a substantial role in the human diet (Stuchlik, 2002). After cereals, oily seeds are the second food sources throughout the world, whose oil is of rich fatty acid types (Siavash, 2005). Mustard oil contains a high amount of selenium and magnesium, which gives it anti-inflammatory properties. It also helps stimulating sweat glands and helps lowering body temperature. In traditional medicines, it is used to relieve the pain associated with arthritis, muscle sprains and strains. Seed paste applied on wounds whereas paste of leaf said to heal cattle wounds (Sood *et al.*, 2010). The purpose of the present investigation was to determine protein, oil, carbohydrate, energy and nutritive value of the *Brassica spp.* species which represent natural resources with potential economic for use in human and animal nutrition.

## II. MATERIALS AND METHODS

Six released varieties of rapeseed and mustard (*Brassica spp.*) were selected for the study. From *Brassica campestris* were BARI Sarisha 9, BARI Sarisha 14, and BARI Sarisha 15. The *Brassica napus* varieties were BARI Sarisha 13. Varieties BARI Sarisha 11 and BARI Sarisha 16 were from the *Brassica juncea* group. The seeds were collected from the oilseeds Research

centre of BARI, Gazipur. Seed were cleaned sun dried and stored into plastic container in a cool place until used for the chemical analysis.

**Total carbohydrate Estimation:** The method was described by Raghuramulu *et al.* (2003). The content of the available carbohydrate was determined by the following equation:

$$\text{Carbohydrate} = 100 - [(\text{Moisture} + \text{Fat} + \text{Protein} + \text{Ash} + \text{Oil/Fats}) \text{ g}/100\text{g}]$$

**Estimation of total protein content by Microkjeldhal method**

Nitrogen content was determined using the Kjeldahl apparatus (KelPlus, Pelican Equipment, Chennai, India) and the amount of nitrogen was multiplied by a factor 6.25. Methods described in AOAC (2010).

**Estimation of oil by soxhlet apparatus**

The fat was determined by the procedure (Hughes, 1965) contains usual lipids including waxes pigments, certain gums and resins. Crude fat was determined using the Soxhlet extractor (Socs Plus, Pelican Equipment, Chennai, India) with ether as solvent. A better name for these constituents would be “ether soluble extract.”

**Estimation of Energy:**

The gross food energy was estimated by multiplying the crude protein, crude fat and total carbohydrate by at water factors 4, 9 and 4 respectively (Okwu, 2006; Osborne and Vooget, 1978).

**Estimation of Moisture**

Moisture content ground nut sample was determined by conventional method i.e., drying in an oven at 100° C for overnight.

**Estimation of Ash**

The sample is ignited at 600° C to burn off all organic material. The inorganic material which does not volatilize at that temperature is called ash. The procedure was described by Ranganna (1986).

**Estimation of Mineral**

The metal composition Zinc, Iron, Copper of the seeds were determined by using an Atomic Absorption Spectrophotometer (Model Varian 240FS+GTA120), after acid digestion. Calcium and magnesium was determined by complexometric titration with 0.1M EDTA, by using Erichrome black T indicator and calculated. (Bachheti,*et al.* 2012)

**Statistical Analysis**

The recorded data for each character from the experiments was analyzed statistically to find out the variation resulting from experimental treatments using MSTAT package program. The mean for all the treatments were calculated and analysis of variance of characters under the study was performed by F variance test. The mean differences were evaluated by Least Significance Difference test.

III. RESULT AND DISCUSSION

**Grain weight**

Weight of Grain grain of different released varieties of mustard and rapeseed have been compared in Table 1. It was found that seed weight varied with their size and shape. Thousand grain weights were determined at 13% moisture level. The highest thousand grain weight was found in BARI Sarisha-13 (4.38g) , This was significantly higher than all others released variety and the lowest thousand grain weight was found in BARI Sarisha-9(3.06g). Statistically similar results were shown by BARI Sarisha-11 (3.567g), BARI Sarisha-14 (3.751g) and Sarisha-16 (3.756g).The present values are consistent with the results reported by Banga *et al.* (2013), Siddiqui *et al.* (2004), Chowdhury *et al.* (2014), Kumar and Singh (1994), Andarhennadi *et al.* (1991), Biswas (1989), Chowdhury *et al.* (1987) and Kaul *et al.* (1986).The present values are higher than the reported value of Mondal and Wahhab (2001).

**Oil cake**

Oil cake/meals are used for various purposes. Oil cake is a nutritious food items for cattle and fish. It is also used as a good organic fertilizer and ingredient of composts. The BARI Sarisha-13 contained significantly highest amount of oil cake (61.25%). The lowest value was found in BARI Sarisha-15 (57.75%).The present values were supported by the reported values of Chowdhury *et al.* (2014) and Appelqvist *et al.* (1992).

**Dry weight of cake**

Dry cakes are used to evaluate the content of different nutrient which are essential for our poultry feed, organic fertilizer and other various purposes. The dry weights of cake has been presented in Table 1. The highest value was obtained from BARI Sarisha-13 (56.65%). Statistically similar results were shown by BARI Sarisha-11 (53.90%) and BARI Sarisha-14 (53.90). The lowest value obtained from BARI sarisha-15 (52.55%).

**Moisture**

Seed deterioration increased as moisture content is increased. Seeds have moisture content of above 18% gets heating, is attacked by molds and insects. Seed stores reasonable well for 6-8 months in temperate climate in open storage at a moisture content from 10%-13%. The moisture content of different released varieties of mustard and rapeseed have been presented in Table 1. The moisture content of different released varieties of mustard and rapeseed was ranged from 4 to 5.2%. The highest moisture content (5.2%) was observed from BARI Sarisha-15; while the lowest moisture content (4%) was found in BARI Sarisha-16. The results of the moisture content were significantly lower than Sarker *et al.* (2015), Al Mahmud *et al.* (2012); BARI annual report (1987-88). These may be influenced by different level of sun drying after harvesting.

**Table 1. Weight of 100 seed, Moisture and ash content of the different varieties of rapeseeds and mustard (*Brassica spp.*)**

Name of varieties (Treatments)	Weight of 1000 seeds (at 13% moisture level)(gm)	Moisture (%)	Ash (%)	Oil cake (%)	Dry wt. of cake (%)
BARI Sarisha-9	3.060 c	4.400 d	12.40 a	59.45 b	55.05 b
BARI Sarisha-11	3.567 b	5.000 b	12.00 a	58.90 c	53.90 d
BARI Sarisha-13	4.380 a	4.600 c	12.50 a	61.25 a	56.65 a
BARI Sarisha-14	3.751 b	4.200 e	9.600 b	58.10 e	53.90 d

BARI Sarisha-15	3.397 bc	5.200 a	11.80 a	57.75 f	52.55 e
BARI Sarisha-16	3.756 b	4.000 f	12.37 a	58.34 d	54.34 c
LSD <sub>(0.05)</sub>	0.4456	0.1993	1.258	0.02573	0.1908
CV (%)	6.72	2.40	5.87	0.01	0.20

Figure in a column followed by a common letter do not differ significantly at 5% level

### Ash

Ash content of different released varieties of mustard and rapeseed were variable and ranged from 9.6% to 12.5% (Table 1). There were no significant variation among the varieties BARI Sarisha-13 (12.5%), BARI Sarisha-9 (12.4%), BARI Sarisha-16 (12.37%), BARI Sarisha- 11 (12%), BARI Sarisha-15 (11.8%). But these values were significantly higher than the BARI Sarisha-14 (9.6%). The present values were significantly higher than the reported value of Sarker *et al.* (2015), Chowdhury *et al.* (2014), Abul-Fadl *et al.* (2011), Nehrins *et al.* (1990), Sosulski *et al.* (1991) and Kaul *et al.* (1986).

### Carbohydrate

Carbohydrate content of different released varieties of rapeseed and mustard were determined moisture free basis. The data have been presented in Table 2. The amount of carbohydrate contained found in BARI Sarisha-13 (17.02%) was significantly highest than other varieties of rapeseed and mustard. The lowest amount of carbohydrate was obtained from BARI Sarisha-15 (12.75%) which was significantly lowest among all the varieties. Agronomics practices, environmental factors as well as variation among the varieties might be influenced the carbohydrate content. The present values are slightly lower than the reported values of Bachheti *et al.* (2012), Chowdhury *et al.* (2014) and Gopalan *et al.* (1981).

### Protein

Protein is the major nutrient components of different varieties of rapeseed and mustard. Protein content is genetically controlled. It is also influenced by nitrogen fertilizer application and agronomics practices. The protein content was determined on moisture free basis. Protein content of different varieties of rapeseed and mustard have been presented in Table 2. Significantly highest amount of protein was obtained from BARI Sarisha-15 (28%), followed by BARI Sarisha-14 (27.62%). The Lowest amount of protein content (26.25%) showed by BARI Sarisha-9 and BARI Sarisha-11. The present values are more or less similar with the reported values of Chowdhury *et al.* (2014), Sarker *et al.* (2015), Chowdhury *et al.* (2010), Nehrins *et al.* (1990), Sosulki *et al.* (1991), and Mirza *et al.* (1998). However these result are lower than those reported by many other authors. Marnoch and Diosady ( 2006); Prapakornwiriya and Diosady ( 2004) determined the protein 45.0% and 34.0% respectively and Sengupta *et al.* (2003) revealed that protein content of rapeseed were ranges from 44.2-44.7%. This might be due to the nitrogen fertilizer application, ecology and agronomics practices.

### Oil content

The oil content of the mustard and rape seeds depends on many factors like genetic factor; agro-ecological conditions include cultivation sites and crop management system etc. The oil content of different varieties of mustard and rapeseed were extracted by petroleum ether (40-60°C) varied from 38.75% to 42.25% (Table 2). The variety BARI Sarisha-13 had the lowest amount of oil contained (38.75%), while the variety BARI Sarisha-15 contained significantly highest amount of oil (42.25%). The results clearly indicated that variety BARI Sarisha-15, BARI Sarisha-14 and BARI Sarisha-16 can be considered as better source of oil. Present values are higher than the reported value of Chowdhury *et al.* (2014), Gadei *et al.*, (2012) and Moser *et al.* (2009); whereas Arif *et al.* (2012), Bhowmik (2003), Novoselov *et al.* (1994) reported values are slightly higher than present results. On the other hand, The present investigations were more or less similar the reported values of Vijay *et al.* (1992), Rathore (1999-2000), Niraz *et al.* (2001), BARI report (2001), Sengupta *et al.* (2003), Mandal *et al.* (2002 ). These variations might be due to biological factor, environmental factor, soil and crop management practices.

### Total energy

Energy from Carbohydrate of mustard and rapeseed varied significantly due to different varieties (Table 2). Significantly the highest amount of energy from carbohydrate found in BARI Sarisha-13 (68.1kca/g), followed by BARI Sarisha-14(66.68kca/g); while the lowest amount found in BARI Sarisha-15 (51kca/g), followed by BARI Sarisha-16 (53.20kca/g). The highest energy from protein observed from BARI Sarisha-15 (112kca/g); whereas significantly the lowest amount of energy (105kca/g) from protein observed from BARI Sarisha-9 and BARI Sarisha-11. The highest amount of energy from fat was observed in BARI Sarisha-15 (380.3kcal/g), which was significantly higher than all other varieties, followed by BARI Sarisha-14 (377.1kcal/g); whereas the lowest amount counted from BARI Sarisha-13 (348.8kca/g). The study found that Total energy of different varieties of rapeseed and mustard ranged from 525.3 to 554.3kcal/g. The highest amount of gross energy found from BARI Sarisha-14 (554.3 kcal/g); while lowest amount of gross energy recorded from BARI Sarisha-11 (537.5 kcal/g), which was significantly similar to BARI Sarisha-9 (535.5 kcal/g). The total energy content of these mustard and rapeseed varieties were found to be comparable to those reported by Okwu, 2006; Osborne and Vooget, 1998.

**Table 2. Proximate analysis of total energy from carbohydrates, proteins and oils of different varieties of rapeseeds and mustard (*Brassica spp.*)**

Name of the variety (Treatments)	Carbohydrate (%)	Energy from Carbohydrate	Protein (%)	Energy from Protein	Oil content (%)	Energy from Oil	Total Energy
BARI Sarisha-9	16.40 c	65.60 c	26.25 e	105.0 e	40.55 e	365.0 e	535.5 d
BARI Sarisha-11	15.65 d	62.60 d	26.25 e	105.0 e	41.10 d	369.9 d	537.5 c
BARI Sarisha-13	17.02 a	68.10 a	27.12 c	108.5 c	38.75 f	348.8 f	525.3 e
BARI Sarisha-14	16.67 b	66.68 b	27.62 b	110.5 b	41.90 b	377.1 b	554.3 a
BARI Sarisha-15	12.75 f	51.00 f	28.00 a	112.0 a	42.25 a	380.3 a	543.2 b
BARI Sarisha-16	13.30 e	53.20 e	26.75 d	107.0 d	41.66 c	374.9 c	535.1 d
LSD (0.05)	0.09965	0.4108	0.1151	0.4709	0.0193	0.1409	0.5607
CV (%)	0.37	0.37	0.24	0.24	0.02	0.02	0.06

Figure in a column followed by a common letter do not differ significantly at 5% level

### Major minerals

#### Calcium (Ca)

In case of calcium content of different released varieties of rapeseed and mustard was ranged from 2.43% to 2.7% (Table 3). Significantly highest amount of calcium (Ca) content was observed in BARI Sarisha-9(2.7%). BARI Sarisha-14 (2.58%) and BARI Sarisha-16 (2.59%), these varieties are statistically similar in respect to calcium content. The lowest amount of calcium content was obtained from BARI Sarisha-15 (2.43%). The present investigations were supported by reported value of Sarker *et al.* (2015), Arif *et al.* (2012), Bachheti *et al.* (2012), Josefson (1988), Sengupta *et al.* (2003) and Pathak *et al.* (1973).

#### Magnesium (Mg)

Magnesium is the major minerals for human nutrition. Magnesium content of different released varieties of rapeseed and mustard have been presented in Table 3. Magnesium content of different varieties was ranged from 0.728% to 0.739%. The highest amount of Magnesium content was found in BARI Sarisha-9 (0.739%); followed by BARI Sarisha-11 (0.737%) and the lowest amount in BARI Sarisha-16 (0.7280%). BARI Sarisha-9 was significantly highest than all other varieties. The

present investigations were supported by reported value of Sarker *et al.* (2015), Arif *et al.* (2012), Bachheti *et al.* (2012), Josefson (1988), Sengupta *et al.* (2003) and Pathak *et al.* (1973)

### Minor minerals

#### Copper (Cu)

Copper contained of different varieties of rapeseed and mustard were ranged from 12.72-14.04 ppm (Table 3). Significantly highest amount of Cu contained observed in BARI Sarisha-14 (14.04 ppm) which was followed by BARI Sarisha-13 (13.86 ppm), BARI Sarisha-16 (13.56 ppm) and BARI Sarisha-15 (13.50 ppm). Lowest amount of Cu contained observed in BARI Sarisha-9 (12.72 ppm) which was followed by BARI Sarisha-11 (13.26 ppm). The present investigations were supported by reported value of Sarker *et al.* (2015), Arif *et al.* (2012), Bachheti *et al.* (2012), Josefson (1988), Sengupta *et al.* (2003) and Pathak *et al.* (1973).

**Table 3. Proximate analysis of minerals content of the different varieties of rapeseeds and mustard (*Brassica spp.*)**

Name of varieties (Treatments)	Ca (%)	Mg (%)	Cu (ppm)	Fe (ppm)	Zn (ppm)
BARI Sarisha-9	2.700 a	0.7390 a	12.72 f	210.5 a	53.34 c
BARI Sarisha-11	2.670 b	0.7370 b	13.26 e	170.7 c	48.93 e
BARI Sarisha-13	2.640 c	0.7340 c	13.86 b	137.9 e	57.00 b
BARI Sarisha-14	2.580 d	0.7320 d	14.04 a	147.5 d	47.94 f
BARI Sarisha-15	2.430 e	0.7300 e	13.50 d	172.3 b	51.48 d
BARI Sarisha-16	2.590 d	0.7280 f	13.56 c	74.70 f	66.90 a
LSD <sub>(0.05)</sub>	0.01819	0.001819	0.01819	0.005753	0.05753
CV (%)	0.31	0.18	0.06	0.01	0.05

Figure in a column followed by a common letter do not differ significantly at 5% level

### Iron (Fe)

Iron contained of different varieties of rapeseed and mustard were ranged from 74.4 to 210.5 ppm (Table 3). Significantly highest amount of Fe contained was observed in BARI Sarisha-9 (210.5 ppm) which was followed by BARI Sarish-15 (172.3 ppm) and BARI Sarish- 11 (170.7 ppm). The variety BARI Sarisha-16 showed lowest amount of Fe (74.7 ppm) which was followed by BARI Sarish- 13 (137.9ppm). These might be influenced the different levels of Fe in soil, Fertilizer and variation among the varieties. The present values were higher than the reported values of Bachheti *et al.* (2012) and Josefson (1988).

### Zinc (Zn)

The zinc content of different varieties of rapeseed and mustard were ranges from 47.94 to 66.9 ppm in (Table 3). Significantly highest amount of Zn contained was found in BARI Sarisha-16 (66.9 ppm) which was followed by BARI Sarish-13(57ppm). The lowest amount was found in BARI Sarisha-14 (47.94 ppm). These treatments are statistically similar. The present values were supported by the reported value of Bachheti *et al.* (2012) and Josefson (1988).

## IV. CONCLUSION

Vegetable Fats constitute an important constituent of the diet because of their high energy value and because of the fat soluble micronutrients. From the results of the present study, it was concluded that along with oil content the rapeseed and mustard are also a good source of protein, carbohydrate and certain minerals. Among the oil seed samples analyzed, BARI Sarisha-9 was a good source of minerals while BARI Sarisha-14 and BARI Sarisha-15 were rich sources of protein and total energy. Other can be utilized for formulation some of the human balance and process foods and some can be used as supplements in animal feeds. 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.

## ACKNOWLEDGEMENT

I would like to gratefully acknowledged Bangladesh Agricultural Research Institute (BARI) for supply seed to study this research. Oil seed Research Division and soil science Division, BARI, Joydebpur, Gazipur is gratefully acknowledged for their kind cooperation regarding the provide Laboratory facilities and financial cooperation for Biochemical analysis of mustard and rapeseed varieties.

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