World Journal of Advanced Research and Reviews
eISSN: 2581-9615 CODEN (USA): WJARAI
Cross Ref DOI: 10.30574/wjarr
Journal homepage: https://wjarr.com/

(RESEARCH ARTICLE)

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Nutritional and lipid composition of *Avena sativa*, *Hordeum vulgare* and *Echinochloa frumentacea*

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World Journal of Advanced Research and Reviews, 2021, 11(03), 023–027

Publication history: Received on 28 July 2021; revised on 31 August 2021; accepted on 02 September 2021

Article DOI: https://doi.org/10.30574/wjarr.2021.11.3.0415

Abstract

The antidiabetic and hypoglycaemic effect of *Avena sativa, Hordeum vulgare and Echinochloa frumentacea* has been explored and proved. The aim of this study was to investigate proximate, essential fatty acids and quantitative analysis of phytochemicals in *Avena sativa, Hordeum vulgare and Echinochloa frumentacea.* These cereals not only help to prevent many diseases but also used as functional ingredients. This study includes the estimation of moisture, ash, fat, fiber, protein, CHO, vitamin C, calcium of *Avena sativa, Hordeum vulgare* and *Echinochloa frumentacea*were determined by titerametric method and zinc, phosphorous and iron were determined by atomic absorption spectrophotometer method (AAS). Quantitative analysis of differential nutrient components was performed by standard methods and estimation of lipid profile were also done. Results indicate that protein and phosphorous of *Avena sativa* (13.7g/100g, 380.3mg/100g) *Hordeum vulgare* (11.5g/100g, 214.7mg/100g) and *Echinochloa frumentacea*(11g/100g, 281.6mg/100g) were observed to be higher. Thus, the study concluded that these cereals contain many differential nutrients component and minerals which plays an important role in nerve signal transmission, which is how your brain and muscles communicate. These cereals are packed with protein, antioxidants and nutrients. Furthermore, its gluten free, an excellent choice for peopleof celiac disease who follow a gluten free diet.

Keywords: *Avena sativa; Hordeum vulgare; Echinochloa frumentacea*; Proximate analysis; Differential nutrient components

1. Introduction

Oats (*Avena sativa*) is one of the most easily available cereals found for nutritional purpose [1]. Oats belongs to family gramineae, known as oats. β-glucan is a soluble dietary fiber that are present in oat grain, bran, oatmeal, which can decrease the absorbtion of glucose and fatty acids from the diet so it lowers the risk of heart disease, hypertension, diabetes and obesity [2]. Many studies show that oats have beneficial physiological benefits towards the reduction of hyperglycemia, hyperinsulinemia these are reduced by oats consumption. β-glucan is inherent in oats provide the positive effects on glycemia and insulin level [3].

"Barley (*Hordeum vulgare*) is preferred not only for its nutritional importance, but also for its nutraceuticals properties. Nutraceutical property of barley active component having the soluble fibre (1-3) (1-4) β-D-glucan or β-glucan [4]. Whole barley are excellent source of fibre, vitamins, minerals and bio active compounds such as carotenoids, vitamin E, phytic acid, β-glucan [5]. Barley has a number of health benefits because of β-glucans to improve the life style disorder, control blood cholesterol and glucose levels and body weight also [6]. The bio active compound of barley offers many health benefits such as, reduce risk of coronary heart diseases, type II diabetes and cancer [7].

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Barnyard (*Echinochloa frumentacea*) millets are commonly known as Japanese Barnyard millet, Ooda, Oadalu, Sawan and Sanwank. Barnyard millet is small in size; it is advanced food grain with high nutritional profile [8]. Barnyard millet is excellent source of macronutrients, micronutrients and nutraceutical components [9]. Barnyard millets have a property of slow sugar releasing after consumption. It makes barnyard a best substitute for the consumption of diabetic people [10]. Radical-scavenging activity of bioactive compounds which possess great interest for their effective role in the prevention of many diseases [11].

2. Material and methods

2.1. Collection of samples

Certified variety of oats, barley and barnyard were purchased from the authorized dealer. Fine powder was prepared in blender, stored in auto seal pouches at room temperature until the time of assaying.

2.2. Determination of proximate composition

Moisture content was determined by using hot air oven until the weight of sample decreased and become constant. Total ash was estimated by weighing the furnace in incinerated residue at 550^0C for 12 hours. Protein content was determined by micro- Kjeldahl distillation method. Total carbohydrate content was determined by the difference method [12]. Crude fat was estimated by Soxhlet method using petroleum ether as a solvent. Crude fiber determined by Acid Alkali digestion method [13].

2.3. Determination of minerals

Aliquots were prepared from the oats, barley and barnyard powder. Vitamin C and calcium (Ca)were determined by Titerametric method,zinc (Zn)phosphorous (P) and iron (Fe) was determined by using atomic absorption spectrophotometer (AAS) method [14].

The data recorded for respective elements was done in triplicate measurements for its authentication and used for standard deviation calculation.

2.4. Lipid profile

Among fatty acids, amount of omega-6, omega-3 and conjugated linoleic acid in the oat, barley and barnyard powder were estimated by GCMS method as described by [15].

Soluble carbohydrate was analyzed by Periodate Oxidation method modified by [16]. Amylose and Amylopectin was determined by the method developed by [17]. Resistant starch was determined by AOAC method as described by [18].

2.5. Differential nutrient components

2.5.1. Preparation of water extract

10g of powders were successively dissolved in 200ml of water in beaker. The extract was evaporated to dryness in a rotatory evaporator or water bath for 72 hours. The obtained extract was stored in a refrigerator at 4^0 C until used. Oxalic acid, phytic acid was described by the method developed by [19]. Tannin, saponin was done according to the procedure as described by [20].

2.6. Statistical Analysis

All the results were shown in Mean and Standard Deviation.

The proximate composition of *Avena sativa, Hordeum vulgare*, *Echinochloa frumentacea*is presented in Table 1. The table shows the Mean±SEM (g/100g) of moisture, ash, fat, fiber, protein, carbohydrate, vitamin C, calcium, iron, phosphorous, zinc content. The proximate data revealed that the moisture content (g/100g) was low in Avena sativa (10.64±0.01), *Hordeum vulgare* (11.73±0.52) and *Echinochloa frumentacea*(8.71±0.03) which was advantageous for prolonging the shelf life of the cereals. The ash content of *Avena sativa* and *Echinochloa frumentacea* was low (1.80±0.00) (4.51±0.01) as compared to *Hordeum vulgare* (14.36±0.44). The fat content of *Avena sativa*was (7.60±0.00) slightly high as compared to*Hordeum vulgare* (1.7±0.29) and *Echinochloa frumentacea*(3.68±0.04). Fiber content in *Avena sativa, Hordeum vulgare* and *Echinochloa frumentacea*ranged from (10.13±0.09), (3.90±0.16), (6.78±0.12). The protein content of *Avena sativa* was (13.7±0.08) which was higher than the *Hordeum vulgare* (11.50±0.50) and *Echinochloa*

frumentacea(11.06±0.04) respectively. Carbohydrates is your body's main source of energy. For instance, fiber is a carbohydrate that aids in digestion, helps you feel full and keeps blood cholesterol levels in check. *Avena sativa, Hordeum vulgare*, *Echinochloa frumentacea* were abundant in carbohydrate content (62.7±0.08), (70.37±0.44), (68.46±0.47).

3. Results and discussion

Table 1 Proximate composition of *Avena sativa, Hordeum vulgare, Echinochloa frumentacea*

Nutrients (per 100g)	***Avena sativa***	***Hordeum vulgare***	***Echinochloa frumentacea***
Moisture (g/100g)	10.64±0.01	11.73±0.52	8.71±0.03
Ash (g/100g)	1.80±0.00	14.36±0.44	4.51±0.01
Fat (g/100g)	7.60±0.00	1.70±0.29	3.86±0.04
Fiber (g/100g)	10.13±0.09	3.90±0.16	6.78±0.12
Protein (g/100g)	13.7±0.08	11.5±0.50	11.06±0.04
Carbohydrate (g/100g)	62.7±0.08	70.37±0.44	68.46±0.47
Vitamin C (mg/100g)	-	-	-
Calcium (mg/100g)	50.11±0.09	27.00±0.81	27.20±0.16
Iron (mg/100g)	3.9±0.08	1.85±0.13	6.20±0.08
Phosphorous (mg/100g)	380.37±0.44	214.70±0.50	281.66±0.09
Zinc (mg/100g)	2.83±0.09	1.36±0.12	4.37±0.09

As per the result of mineral analysis no vitamin C (mg/100g) is present in cereal grain. Calcium is the most abundant mineral in the body which is vital for bone health. It is a co-factor for many enzymes, without calcium, some key enzymes cannot work efficiently. Appreciable amount of calcium was present in *Avena sativa* (50.11±0.09) as compared to *Hordeum vulgare* (27.00±0.81) and *Echinochloa frumentacea* (27.20±0.16). *Avena sativa* and Hordeum vulgare were low in zinc (2.83±0.09) (1.36±0.12) than the *Echinochloa frumentacea* (4.37±0.09). Phosphorous content was found in appreciable amount in *Avena sativa* (380.37±0.44), *Hordeum vulgare* (214.70±0.50) and *Echinochloa frumentacea* (281.66±0.09). Iron was remarkably reported low in Avena sativa (3.9±0.08), *Hordeum vulgare* (1.85±0.13) and *Echinochloa frumentacea* (6.20±0.08). Thus, regular consumption of whole grain are excellent choices for breakfast and snacks which help to lower cholesterol, prevent type II diabetes and help to keep you regular.

Table 2 Essential fatty acids of *Avena sativa, Hordeum vulgare, Echinochloa frumentacea*

Lipid profile	***Avena sativa***	***Hordeum vulgare***	***Echinochloa frumentacea***
Soluble CHO (g/100g)	0.02±0.00	0.03±0.00	0.04±0.00
Amylose (mg/100g)	3.27±0.00	1.48±0.00	4.15±0.00
Amylopectin (mg/100g)	1.50±0.00	1.32±0.00	1.44±0.00
Resistant starch (gm/100g)	1.70±0.00	2.13±0.00	2.13±0.00
Omega 6 (g/100g)	2.19±0.00	1.16±0.00	-
Omega 3(mg/100g)	0.12±0.00	0.12±0.00	-
Conjugated linoleic acid (g/100g)	13.24±0.00	12.05±0.00	8.90±0.00

The results of lipid profile are shown in Table 2. Negligible amount of soluble CHO (g/100g) were present in *Avena sativa, Hordeum vulgare*, *Echinochloa frumentacea.* Amylose content (mg/100g) was low in *Hordeum vulgare*

(1.48±0.00) as compared to *Avena sativa* (3.27±0.00) and *Echinochloa vulgare* (4.15±0.00). Amylopectin content in *Avena sativa, Hordeum vulgare* and *Echinochloa frumentacea*were ranged from (1.50±0.00), (1.32±0.00), (1.44±0.00). The amount of resistant starch (g/100g) present in *Avena sativa is* low (1.70±0.00) than *Hordeum vulgare* (2.13±0.00) and *Echinochloa frumentacea* (2.13±0.00). Omega 6 (g/100g) and Omega 3 (mg/100g) of *Avena sativa* and *Hordeum vulgare* ranged from (2.19±0.00), (1.16±0.00) and (0.12±0.00), (0.12±0.00). No omega 6, 3 presents in *Echinochloa frumentacea*. Conjugated linoleic acid (g/100g) content of *Avena sativa* was observed to be highest (13.24±0.00) as compared to *Hordeum vulgare* (12.05±0.00) and *Echinochloa frumentacea* (8.90±0.00).

Table 3 Differential nutrient components of *Avena sativa, Hordeum vulgare, Echinochloa frumentacea*

Phytochemical analysis	***Avena sativa***	***Hordeum vulgare***	***Echinochloa frumentacea***
Oxalic acid (mg/100g)	36.70±0.50	2.2±0.16	0.02±0.00
Phytic acid (mg/100g)	1.07±0.04	2.4±0.08	3.49±0.05
Tannin (g/100g)	5.55±0.47	2.46±0.41	4.93±0.04
Saponin (g/100g)	1.23±0.04	2.36±0.06	8.90±0.00

The results of phytochemicals showed the amount of oxalic acid, phytic acid, tannin and saponin in aq. extract of *Avena sativa, Hordeum vulgare* and *Echinochloa frumentacea,* in which oxalic acid (mg/100g) of *Avena sativa* was observed to be highest as compared to *Hordeum vulgare* and *Echinochloa frumentacea.* Phytochemical rich food improves insulin sensitivity and are required for normal physiological functions.

4. Conclusion

This study indicated that *Avena sativa, Hordeum vulgare* and *Echinochloa frumentacea* selected in the research depicts significant clinical and pharmacological activities. They provide many nutrients to the human body as it is rich in phosphorous, protein. They have hypoglycaemic, hypolipidemic and blood pressure lowering property. B- glucan presents in these millets tend to form a gel like substance in your gut which reduce the digestion process and absorption of nutrients, which promote fullness. These are very helpful to maintain good health, therefore it can be easily recommended for human health.

Compliance with ethical standards

Acknowledgments

We are thankful to the department of Food Science and Nutrition, Banasthali Vidyapith for providing necessary lab facilities.

Disclosure of conflict of interest

There is no conflict of interest between the authors.

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