

Original Research Article

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Identification of Potential Donors for Higher β - Glucan Content in Oats *Avena sativa* L. Germplasm

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ABSTRACT

Keywords

Estimation, β - glucan, Dietary fiber, Alkaline extraction

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The common oat (*Avena sativa*) is a cereal grain species considered to be the most economical and the richest source of the soluble dietary fiber. Soluble fiber content in oats is the main reason of the valuable effects of the crop. It is. In the present study, the estimation of β - glucan content was carried out on a total of 95 genotypes of oat which were procured from NBPGR, New Delhi. The isolation and estimation of the β - glucan content was done by using the alkaline extraction method. The β - glucan content in the studied genotypes ranged from 0.43 % to 6.90%. Only 4 germplasm lines had significantly higher β - glucan over standard check OL 10 (5.79%). These were the exotic germplasm lines viz. EC 537851, EC 246158, EC 528874, EC 372463. These could serve as the donors for higher β - glucan content in the oat breeding programmes.

Introduction

Avena sativa L. is a cereal grain species which is prominently cultivated for consumption as a human food as well as animal feed (Daou and Zhang 2012). Oat usage in human foods has increased as information on its beneficial nutritional properties has come to light. This wonder cereal grain is referred to as 'Super grain' because of its impressive health benefits

(Smulders *et al.*, 2016). These beneficial effects are attributed to the soluble fiber content present in the oat grain. β - glucan, a class of polysaccharides is the major component of soluble fiber in oats.

B - glucan is a hemicellulose which makes up about 75 percent of endosperm cell walls of oat grain (Miller *et al.*, 1995). In barley and oats, β - glucan is consists of mixed-linkage (1, 3) (1, 4) - β - D- glucose units (Tohamy *et*

al., 2003). Scientific research has constantly been emphasizing on the importance of oat β -glucan in the human diet. Oat β -glucan is directly related to health improvements like blood pressure, lowering bad cholesterol, improving diabetes and immune response (Keenan *et al.*, 2002, Braaten *et al.*, 1994, Jenkins *et al.*, 2002, Estrada *et al.*, 1997, Kaur *et al.*, 2019). Oat crop is gaining economical interest because of its unmatched health implications.

As a result of this substantial breeding efforts have focused on increased β - glucan content. Therefore, identification of the genotypes having high β - glucan content can be useful for enhancing the β - glucan content of local germplasm lines by different breeding strategies (Ahmad *et al.*, 2014).

In this study, we carried out the estimation of β - glucan content of oat genotypes and screened those for higher β - glucan content, so that these could be useful for different breeding programs for oat improvement.

Materials and Methods

A total of 95 genotypes of hexaploid oats were used for the present research. These genotypes included germplasm lines of exotic and indigenous origin. 65 genotypes were of exotic origin and remaining 30 were indigenous collection. All of these were made available by National Bureau of Plant Genetic Resources, New Delhi.

Estimation of β - glucan content

The process of extraction and estimation of β - glucan content is extremely difficult. Despite this, it has been continued to be developed over the years. There are several methods of isolation of β - glucan i.e., acid extraction, alkaline extraction and enzymatic extraction (Daou and Zhang, 2012). Here, in our study, we used alkaline extraction method outlined by Woods *et al.*, 1977. The reagents used in this method were sodium carbonate, sodium bicarbonate, 2 mol/L HCl and isopropanol (Fig. 1).

Table.1 Cataloguing of germplasm on the basis of β - glucan content values

Beta glucan %	Frequency of individuals	Accession Names
0-2	28	IC 372489, EC 246200, EC 537924, HFO 504, EC 246131, EC 537875, IC 372437, IC 372466, EC 537815, HFO 865, EC 528864, EC 209452, EC 537853, EC 528908, IC 372482, EC 246179, IC 372496, IC 372457, EC 537811, IC 372441, EC 528871, IC 372424, EC 209524, OL 11, IC 372442, P 7 295932, IC 372563, IC 372527
2-4	44	EC 537834, EC 528899, EC 537867, EC 246147, HFO 873, IC 372467, HFO 868, EC 528906, EC 537825, EC 209346, IC 108477, IC 372510, EC 246181, EC 537885, EC 537855, EC 246120, EC 533788, HFO 864, IC 372478, EC 528925, EC 528919, EC 537819, EC 528907, EC 537836, EC 528923, EC 246166, EC 246176, IC 372477, EC 537878, EC 209589, EC 537869, IC 372474, EC 131639, EC 246178, HFO 870, P 7 292561, EC 537849, EC 528902, IC 372529, IC 372462, IC 372452, IC 372503, EC 209272, EC 209576
4-6	20	IC 372415, IC 372481, EC 537850, IC 372458, IC 372493, EC 246112, EC 528916, IC 372502, EC 246132, EC 528905, IC 372497, HFO 505, EC 528896, EC 209402, IC 372530, IC 372531, EC 537856, EC 537808, IC 372523, EC 528888
Above 6	4	EC 537851, EC 246158, EC 528874, EC 372463

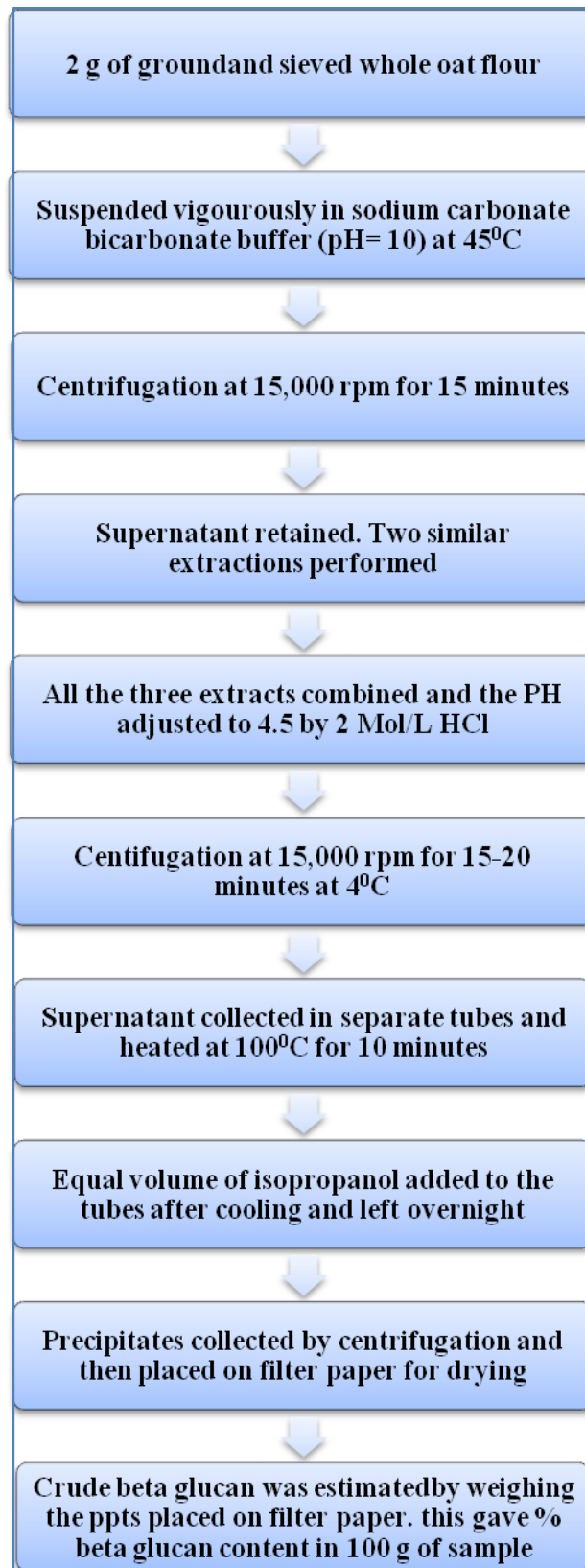


Fig.1 The extraction procedure of β – glucan (Wood et al., 1977)

Results and Discussion

The genotypes were catalogued on the basis of β - glucan content. It ranged from 0.43% to 6.90%. Accessions viz; IC 372415, IC 372481, EC 537850, IC 372458, IC 372493, EC 246112, EC 528916, IC 372502, EC 246132, EC 528905, IC 372497, HFO 505, EC 528896, EC 209402, IC 372530, IC 372531, EC 537856, EC 537808, IC 372523 and EC 528888 were estimated to have the β - glucan content in the high range i.e. 4.0 % to 6.0 %. A total of four genotypes viz. EC 537851, EC 246158, EC 528874, EC 372463 yielded highest β - glucan content even higher than standard check i.e., above 6.0 %.

Twenty eight genotypes were found to have the β - glucan content in lower range i.e. from 0.43 % to 2.0 % (Table 1). The frequency distribution of the genotypes is also shown in Fig. 2. These results were within the range of previously reported studies.

The β - glucan content in oat grains of different accessions ranged 1.98 % - 6.24 % (Silveria *et al.*, 2016), 2.93 % - 3.56 % (Mut *et al.*, 2018), 1.02 % - 6.33 % (Rauf *et al.*, 2019). The content of β - glucan in oats is affected by various factors such as oat cultivars, growing seasons and G X E interaction (Herrera *et al.*, 2015, Lim *et al.*, 1992, Anderson *et al.*, 2011).

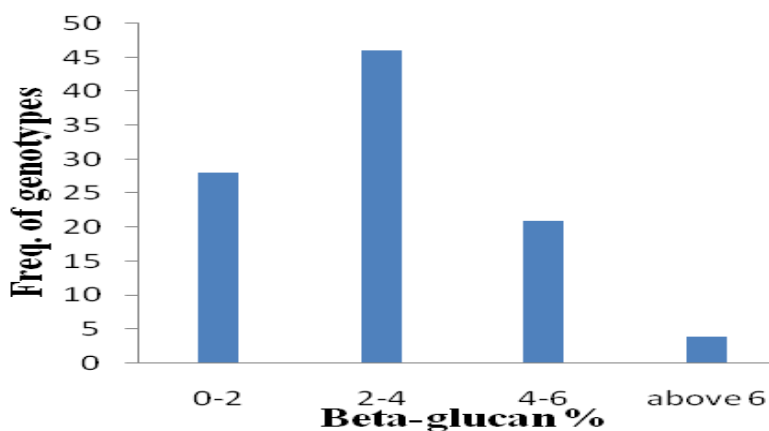


Fig.2 Frequency distribution graph of individuals for β - glucan content

The results of our study yielded a total of 24 promising genotypes which could be useful for future oat breeding programs. These are the lines with higher β - glucan content. They can serve as potential donors in oat improvement programs for developing the varieties with higher β - glucan values. These selected genotypes can be further characterized by using molecular approaches to find the genetic regions controlling the trait.

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