

**EXECUTIVE SUMMARY
(UGC MAJOR RESEARCH PROJECT)**

1. TITLE OF THE PROJECT: Characterization of bio-macromolecules in seeds of some wild and cultivated species of *Chenopodium*.

2. NAME OF THE PRINCIPAL INVESTIGATOR

Dr. Balwinder Singh

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3. OBJECTIVES OF THE PROJECT:

- a) To study physical and chemical properties of seeds from wild and cultivated chenopodium species.
- b) To evaluate proximate composition of seeds of wild and cultivated chenopodium species.
- c) To evaluate composition and properties of carbohydrates present in seeds of wild and cultivated chenopodium species.
- d) To study seed protein profiles of wild and cultivated chenopodium species.
- e) To study flour properties of wild and cultivated chenopodium species.

4. ACHIEVEMENTS FROM THE PROJECT:

The present research work provides information on bio-macromolecules aspects of chenopods (quinoa and bathua) which are still recognized as underutilized crops of India. Bathua and Quinoa produces highly nutritious seeds containing high protein content which can make human diet more balanced and can play an important role in combating 'silent hunger' among poor populations in India who have little access to protein rich diet. The low water requirement makes them suitable for cultivation on desert areas of India where assured irrigation does not exist and farmers have to depend on seasonal rains. Characterization of bio-macromolecules is useful for plant breeders as it would enable them to quantify variability for different traits and their interactions in different *Chenopodium* species.

5. SUMMARY OF THE FINDINGS (IN 500 WORDS):

Seeds of thirty six *Chenopodium quinoa* (quinoa) lines and one *Chenopodium album* (bathua) line were evaluated for seed weight, bulk density and hydration capacity. Diversity in seed weight was observed among quinoa lines. 1000 seed weight ranged from 0.55 to 1.732 g/ml, bulk density of quinoa seeds was observed in the range of 0.62 to 0.75 g/ml and hydration capacity varied from 0.021 to 0.103 in quinoa lines. 1000 seed weight was observed as 1.201g, bulk density was 0.82 g/ml and hydration capacity was observed as 0.072 g/g in bathua seed line. The flour samples obtained from seeds of quinoa and bathua were evaluated for proximate

composition (ash, fat and protein content), functional properties (water absorption, oil absorption, bulk density, porosity etc), phenolic content and antioxidant activity. Ash content was reported in the range of 1.01 to 4.41 %, fat content ranged from 2.3 to 13.1 % and protein content varied from 14.01% to 19.65 % in flour samples of 36 quinoa lines. Moisture, ash, fat and protein content in the flour of bathua seed was reported as 8.95, 3.21, 7.12 and 14.08 g/100g, respectively. Bulk density was noticed in the range of 0.57 to 0.69 g/ml, water absorption capacity varied from 1.22 to 2.17 g/g and oil absorption capacity (FAC) was reported in the range of 0.9 to 2.22 g/100g for flour samples of 36 quinoa lines. Bulk density and true density of bathua flour sample was reported as 0.62 and 1.34 g/ml, respectively and porosity was 53.70%. The values of water absorption capacity and water solubility index was 1.80 and 3.89 g/100g, respectively and oil absorption capacity was observed as 2.12 g/100 g. for bathua seed flour sample. Total dietary fibre of bathua seed flour was reported as 32.8 g/100 g. Total phenolic content ranged from 260.5 to 795.9 mg GAE/100 g and antioxidant activity (DPPH inhibition values) varied from 5.55 to 10.00 $\mu\text{mol TE/g}$ in flour samples of 36 quinoa lines. Bathua seed flour exhibited antioxidant activity of 7.63 TE/g and contains TPC of 257 $\mu\text{g GAE/g}$. The flours from different quinoa varieties showed bio-modal particle size distribution with the presence of particles of less than 100 and more than 100 μm . Quinoa flour showed 6 major bands and some minor bands in SDS-PAGE. The main polypeptides of molecular mass around 59, 53, 32, 26, 19, 17 kDa were observed in quinoa lines. Gluten-free eggless rice muffins were prepared using various levels (0, 25, 50, 75 and 100%) of quinoa flour in rice flour. The physicochemical and sensory properties and shelf life of the resulting muffins were studied. Muffins prepared from quinoa (25%) and rice (75%) flour had maximum acceptability and sensory quality and flavour, while those having 75% quinoa flour and 25% rice flour had the maximum volume and texture properties. The above study indicates that quinoa and bathua are rich source of bioactive constituents and nutrients that can be grown in dry areas to fill a valuable niche in the production of human food. These chenopods are known for the ability to grow under adverse environmental conditions like drought and high salinity.

6. CONTRIBUTION TO THE SOCIETY:

This work provides complete information on variability in important ingredients in the seeds of important quinoa lines. Research work of the project evaluated essential quality determining characteristics of chenopods (such as protein content, fat content, phenolic content and antioxidant activity) and functional properties of flours (water absorption, oil absorption, density, porosity etc) to determine their suitability for consumption and use in different food products. Quinoa and bathua seeds are suitable for the development of different food products. This information is useful for the industry interested in milling and processing of food products from quinoa and bathua. This information is also useful for the farmers interested in growing quinoa and bathua.

7. WHETHER ANY PH.D. ENROLLED/PRODUCED OUT OF THE PROJECT: NA

8. PUBLICATIONS OUT OF THE PROJECT:

Papers submitted

1. **Singh, B.** and Kaur, A. (2020) Comparative study of phenolic content, antioxidant activity, physiochemical and functional properties of Indian quinoa (*Chenopodium quinoa*) lines. *Food Chemistry* (Communicated)(**IF: 6.30**) (Elsevier)

Papers Published

2. **Singh, B.,** Singh, J.P., Shevkani K, Kaur, A. and Singh, N.(2016)Bioactive constituents in pulses and their health benefits. *Journal of Food Science and Technology*54(4): 858–870. (**IF: 1.85**) (Springer)
3. **Singh, B.,** Singh, J. P., Singh, N., &Kaur, A. (2017). Saponins in pulses and their health promoting activities. *Food Chemistry*. 233: 540–549 (**IF: 6.30**) (Elsevier)
4. **Singh, B.,** Singh, J. P., Singh, N., &Kaur, A. (2017).Phenolic composition and antioxidant potential of grain legume seeds. *Food Research International* 101: 1-16 (**IF: 4.97**)(Elsevier)

Paper Presented in Conferences

5. Presented research paper entitled 'Comparative study of physiochemical properties of quinoa lines' in 25th Indian Convention of Food Scientists and Technologists (ICFoST-XXV) at Guru Nanak Dev University, Amritsar (November 10-12, 2016)

Participation in conferences

- 6.Participated and chaired technical session of 25th Indian Convention of Food Scientists and Technologists (ICFoST-XXV) at Guru Nanak Dev University, Amritsar (November 10-12, 2016)