BUCKWHEAT:AN ADVANCING CROP FOR FUTURE GENERATIONS

Abstract

Common buckwheat is most widely cultivated and utilized, while Tartary buckwheat is mainly grown and consumed in China. It is consumed in the form of groats and flour, which are used as food items. Raised in short season and as the second crop. Most reliable summer season crop.Antioxidant activity is the fundamental prophylactic property important for the human organism. A variety of biological functions, e.g. antimutagenic, anticarcinogenic, and antiaging, originate from that property. The molecular basis for the technological and textural characteristics of buckwheat products is recently studied and haswider applications in future generations

Keywords: buckwheat, season crop, summer weeds, gluten-free product

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INTRODUCTION:

Buckwheat (Fagopyrum esculentum) is one of the most important green manure crop and semi-succulent dicot plant which belong to the genus Fagopyrum and the family Polygonaceae(Cai andCorke.,2004,).Hence its name. It is a pseudocereal crop (seeds that are consumed in the same way cereal grains but are not grown on grasses) and there are two cultivated species, i.e., common buckwheat (Fagopyrum esculentum) (USDA 2014) and Tartary buckwheat (Fagopyrumtataricum). Common buckwheat is most widely cultivated and utilized, while Tartary buckwheat is mainly grown and consumed in China. It is consumed in the form of groats and flour, which are used as food items. Raised in short season and as the second crop. Most reliable summer season crop. It establishes quickly, which suppresses summer weeds. Björkman; Bellinder; Hahn &Shail 2008).

Comment [TR2]: Follow the style of this recommended journal Cai and Corke, 2004).

Comment [TR3]: You need to read the previous published paper of this journal (Björkman et al., 2008)

Buckwheat tea, known as memil-cha in Korea and soba-cha in Japan, is a tea made from roasted buckwheat (Kim and Dakota, 2015). Buckwheat is rich in protein of excellent quality as well as starch. In addition, it also contains high levels of fiber, minerals, vitamins, and flavonoids with positive therapeutic effects on the human body Buckwheat has increasingly attracted attention because of its positive effects on some chronic diseases conditions, such as hypertension, hypercholesterolemia, diabetes, and other cardiovascular diseases.it is also used as a functional food source. (Caiand Corke,2004).

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In India, it is called kuttukaatta and is eaten in Navratris. It is a non-cereal flour commonly used for making parathas, and pakodas in Indian families.(Bhaduri, NitiPathak; Prajneshu, Meenakshi 2016).It is cultivated for its nutritious triangular seeds and is a cover crop. The grains are usually brown and irregular

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in shape. It's a completely gluten-free product. Buckwheat has been used as a substitute for other grains in gluten-free beer (Carolyn Smagalski 2006).Buckwheat consumption is linked with several health benefits, including improved blood sugar control, hypertension, hypercholesterolemia, diabetes, and other cardiovascular diseases. It also has anti-inflammatory properties. It's a gluten-free crop and is safe for people with celiac disease. Roasted buckwheat groats, called kasha. Buckwheat has more protein than cereals (LINK or Citations). High amounts of essential amino acids lysine and arginine are present which are deficient in major crops. Its unique amino acid profile gives buckwheat the power to boost the protein value of beans and cereal grains eaten the same day which is a key advantageous feature for us. Buckwheat contains no gluten. Nevertheless, buckwheat may have gluten contamination(Ciacciet al., 2015). Buckwheat flower produces honey of good quality. Tahir et al. (1989) studied that Buckwheat can become an important crop in the feeding of mankind and domestic animals to meet the ever-increasing demands of a rapidly expanding population. It has the ability to prevent or reduce weed growth.(Mazurek and Wielgo, 2001).

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Ben-Nun, L. (2022). The validity of buckwheat for human nutrition. Available at: https://www.researchgate.net/publication/359710267_THE_VALIDITY_OF_BUCKWHEAT_FOR_HUMAN_NUTRITION

Comment [TR7]: Don't put dot before the text citation {weed growth (Mazurek and Wielgo, 2001)}.

ORIGIN AND HISTORY:

The wild ancestor of common buckwheat is F. esculentum ssp. ancestrale. F. homotropicumis interfertile.Yunnan in china has a common distribution of f.esculentum.The wild ancestor of Tartary buckwheat is F. tataricum ssp. Potanini. (Ohnishi, Matsuoka, 1996).The oldest remains found in China so far date to circa 2600 BCE, while buckwheat pollen found in Japan dates from as early as 4000 BCE. Buckwheat was one of the earliest crops introduced by Europeans to North America (OSHINI 1998). Also called beech wheat, which resembles the much larger seeds of the beech nut from the beech tree.("Online Etymology Dictionary". Etymonline.com. Retrieved 2022-11-24.)

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Comment [TR11]: Don't put dot before the sentence end and kindly use (Ohnishi and Matsuoka, 1996).

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Follow the journal text citations style
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GEOGRAPHICAL DISTRIBUTION:

In 1993, history played a record in making Russia the largest producer of buckwheat. It is reported that in 1990, buckwheat yield per hectare reached 3400 kg in Russia. China has the longest history (since the seventh century AD) of buckwheat cultivation, and now ranks second in world production with an average annual cultivation area of 1.33Mha. Buckwheat grows mainly in the northern hemisphere, notably in Russia, China, Japan, India, Kazakhstan, China, Poland, Ukraine, Canada, and the USA. Buckwheat is also planted in the southern hemisphere, e.g., in Brazil, Australia, and South Africa (Cai andCorke, 2004). Globally Russia is the leading producer of buckwheat. As of 2016, it remains a key cereal (Steve Rosenberg 2019 or 2014).

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Table 1. Producer of buckwheat

Russia	1,186,333
China	404,259
Ukraine	176,430
France	122,206
Poland	118,562
Global production	2,395,822

Ref:faosat of united nation

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Follow the journal text citations style
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In India, the crop is widely cultivated in Jammu and Kashmir), Himachal Pradesh, Uttarakhand (Uttar Kashi, Chamoli, Pauri, Almora, and Pithoragarh), West Bengal, Sikkim, Meghalaya, etc. In South India, it is sporadically grown in the Nilgiris and Palni hills.{aditnandanyadav 2017}

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Follow the journal text citations style
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Shah (2013) studied explored buckwheat in North West Jammu & Kashmir. Kump and Javornik, (2002) report state that it is grown as a minor grain crop in high-altitude areas in India. (1600-4000 m above mean sea level). It's cultivated in the hills of the states of Jammu & Kashmir, Himachal Pradesh, Uttaranchal, Sikkim, Manipur, and Arunachal Pradesh under low input conditions and gets exposed to harsh environments. Most important crop for the people of the Uttarakhand state. However, the productivity of buckwheat is quite low (4.5 q/ha) in Uttaranchal. Two species of buckwheat are prevalent in Uttaranchal viz., common buckwheat (Fagopyrumesculentum, Moench) locally called Ugal, and tartary buckwheat (F. tataricumGaertn.) locally known as Phapar. VPKAS, Almora developed and released a variety of F. esculentum (VL Ugal 7) in 1991. However, this variety performs well only in mid-altitude areas (1000-1500 meters above mean sea level). About 800 years ago tartary buckwheat appeared suddenly on 47-60° northern latitude.

NUTRITIONAL VALUES:

The main storage protein of buckwheat grains is 13S globulin (Aubrecht&Biacs 1999; & Zhang 2001). Important microelements such as Zn, Cu, Mn, and Seare were found (Stibilj et al., 2004), and the major elements are potassium, sodium, calcium, and magnesium(Wei et al., 2003). The average albumin content is 21%, whereas the highest one reaches 30–33% (Bharali and Chrungoo, 2003). Mistunaga et al. (1986) first isolated the thiamin-binding proteins (TBP) from the grains of buckwheat. The main reason for immunological disorders is low molecular weight proteins, particularly those with digestible starch (SDS), and molecular weights of 15, 22, or 26 kDa(Yoshioka et al. 2004; Handoyo et al. 2006; Morita et

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Aubrecht and Biacs, 1999; and there is no reference on the name of Zhang in reference list.

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al. 2006). From the nutritional point of view, there exist three fractions of starch: rapidly digestible starch (RDS), and slowly resistant starch (RS). It could show a similarity to dietary fiber. In uncooked buckwheat grains, RS continents of dietary fiber are found. Total dietary fiber (TDF) is classified into 2 types insoluble dietary fiber (IDF) and soluble dietary fiber (SDF). In general, IDF includes cellulose, lignins, and certain non-cellulosic polysaccharides, while SDF includes pectin's and some associated non-cellulosic polysaccharides (Asp et al. 1993; Brennan 2005; Young et al. 2005). The whole grains contain 7% TDF, while the bran with hull fragments has 40% TDF (Steadman et al. 2001). Dietary fiber consists also of oligosaccharides, polysaccharides, and other hydrophilic derivatives (Gibson et al. 2000). Polyunsaturated fatty acids (PUFA), such as n-3 and n-6, are often referred to as factors provoking the modulation of the immunological system in humans (Jelińska 2005). Buckwheat grains were also demonstrated to contain vitamins: B1, B2, and B6 (Fabjan et al. 2003). Antioxidant activity is the fundamental prophylactic property important for the human organism. A variety of biological functions, e.g. antimutagenic, anticarcinogenic, and antiaging, originate from that property (Holasová et al. 2002). Rutin, quercetin, orientin, vitexin, isovitexin, and isoorientin were identified in buckwheat hulls (Dietrych-Szóstak and Oleszek, 1999, 2001). Catechins and phenolic acids are also present in buckwheat grains.(Przybylski et al., 1998).The unique amino acid profile gives buckwheat the power to boost the protein value of beans and cereal grains eaten the same day.

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Table 2. The nutritional content of buckwheat in 100g

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Name	**Amount**
Water	9.75 g
Energy	343 kcal
Energy	1435 kj
Protein	13.25 g
Total lipid[fat]	3.4 g
Ash	2.1 g
Carbohydrate,by difference	
Total dietary fibers,	10 g
Calcium	18 mg

Iron	2.2 mg
Magnesium	231 mg
Phosphorous	347 mg
Potassium	460 mg
Sodium	1 mg
Zinc	2.4 mg
Fatty acids,totalmonosarturated	1.04 g
Fatty acids,totalpolysaturated	1.039 g
18:2	0.961 g
18:3	0.078 g
aspartic acid	1.133 g
Glutamic acid	2.046 g
Glycine	1.031 g

Acceptable for consumption in Hindu fast especially during Navratri. Buckwheat pancakes, with yeast, are tasty. They are light and foamy... Buckwheat noodles play a major role in the cuisines of Japan (soba) (P. S. Belton; John Reginald Nuttall Taylor 2002). Buckwheat flour is also used to make Nepali dishes such as dhedo and kachhyamba. Buckwheat starch a jelly called memilmuk is made in Korea. Buckwheat is a good honey plant, producing dark, strong monofloral honey.(Buckwheat%20-%20Wikipedia.html)

Note: Eriogonum, a genus of wild North American plants also known as buckwheat

The anti-oxidative potential is high, mainly in buckwheat leaves, because of the presence of tocopherols and phenolic substances, such as 3-flavonols, flavonol, rutin, phenolic acids, and flavonoids (Oomah et al. 1996; Watanabe et al. 1997; Holasova et al. 2002; Kalinová et al. 2011; Shao et al. 2011). Only crops containing rutini.e in high quantities (Fabjan 2003; Sun and Ho 2005; Brunori et al. 2009; Vojtišková et al. 2012). This compound has anti-oxidative and anti-inflammatory actions and reduces blood vessel weakness (Pisha and Pezzuto 1994; Hagels 1999). Rutin content represents 2-10% of the dry weight of the plant in buckwheat and is essential. Seeds of buckwheat are richer in rutin than albumen.(Hagels 1999; Park et al. 2000; Kreft et al. 2003; Baumgertel et al. 2010; Gulpinar et al. 2012; Vojtišková et al. 2012). Rutin helps to limit blood platelet coagulation (Kawakami et al. 1995). Pollinated flowers with a normal-sized gynoecium that do not set seeds after pollination are the main contributors to the low seed

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set in buckwheat that do not set seeds after pollination are the main contribution to the low seed set in buckwheat.

Effect of climate on buckwheat :

Based on the variation in altitude Tartary buckwheat has frost tolerance capacity since it is grown at higher altitudes and common buckwheat is grown in lower altitude conditions. Gaberscik et al. (1986) found little frost resistance when they tested buckwheat in a climatic chamber at optimal humidity of 60-80%. Buckwheat thrives well on sandy, well-drained soils. In limiting moisture it is sensitive to high wind conditions. A condition called 'blasting results in the loss of flowers.

1. **Temperature:**Seed maturity is reached after an average of 3 months of cultivation in temperate regions.it is frost sensitive so there are very less crops at low altitudes.10°C is the optimal temperature for germination(Jakimenko 1982 in Kalinová and Moudr2003). The developmental stage most sensitive to frost is one to two expanded leaves. At this stage, exposure for 4 to 6 h to temperatures between –1 to –3°C is lethal (Kalinová andMoudr2003) Pollen viability is similarly dependent on temperature and on relative humidity. At 23ºc in dry air pollen lose its viability in one hour. (Adhikari and Campbell 1998).

2. **Water:** A quantity of 225-315 kg of water is needed to produce 1 kg of seeds (Gang and Yu 1998). Plants quickly wither under drought conditions because of their shallow root system (Marshall and Pomeranz 1982; Myers and Meinke 1994; Berglund 1997; Campbell 1997).water supplied at the reproductive phase is more beneficial than at the reproductive phase. Flooding for more than 10 days at the flowering stage or more than 3 days during the maturation stage affects seed weight (Sugimoto and Sato 2000).
3. **Photoperiod:**photosensitive varieties should preferentially be cultivated under short photoperiods in order to gain larger yields.

Buckwheat generally is not attacked by a disease or pest but some of the diseases were recorded.**Bugg and Ellis (1990)** noted that insect visitation to buckwheat was low during afternoons, whereas insects continued to visit white-sweet clover. Pellett **(1976)** states that nectar production is stopped by buckwheat in the afternoon.

Table 3. List of disease in Buckwheat reviewed by Joshi and Paroda (1991).(sun he hu et al. 2010)

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Name of Disease	Causal Organism
Brown leaf spot disease	Ascochytaitalica
Chlorotic leaf spot disease	Alternariaalternate
Downy mildew disease	Peronosporaducumet
iLeaf spot disease	Septoriapolygonicola
Powdery mildew disease	Erysiphepolygoni
Root and collar rot disease	Sclerotinialibertiana
Root and stem rot disease	Phytophthorafagopyri
Root rot disease	Fusarium spp.
Rust disease	Pucciniafagopyri
Smut disease	Sphacelothecafagopyri
Stem rot disease	Botrytis cinerea
Stipple spot disease	Bipolarissorokiniana

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Table 4. List of pests in Buckwheat reviewed by(Joshi and Paroda 1991). (sun he hu et al. 2010)

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Name of pests	Causal Organism
Bruchids	Acanthecelidsobtectus
Cutworms	Cirphis spp.
Grain moth	Cephitinea
Storage beetles	SpMycetophagus sp.

BIOTECHNOLOGY:

According to theresearchers reports there is an increase in the numbers of aerobic, mesophilic, and lactic acid bacteria with the buckwheat products.They observed a slight decrease of Enterobacteria and fewer pathogenic bacteria confirming potential prebiotic components in the human gastrointestinal tract. During the extrusion process (Fornal et al. 1987a), biopolymers like proteins and starch coming from several sources underwent physicochemical and structural transformations (Fornal et al. 1985, 1987b). The possibility of small and weak crystallite formation at various levels of aggregation can be understood by a change in structure.(Soral-Śmietana 1992).

Table 5. Country holding germplasm collections (> 5 accessions), storage conditions, evaluation of germplasm and details of the collections being store.

Country	Storage Conditions	Evaluation Collection	Details of collection
India	medium term	402 acc. were evaluatedfor 31 trait	60 of F. esculentum var. emarginatum, 316 assesions of F. esculentum 197 of F.tataricum, 25 F. tataricum var. himalianum; 3F.giganteum; 5 F. cymosum

(Campbell clayton G1997)

The self-incompatibility of buckwheat is of the sporophytic and dimorphic type. The discovery of flower forms with reduced styles was done.(Marshall 1969). Some special lines adapted to self-pollination were developed. Self-incompatibility was thought to be restored by single dominant genes (Sharma and Boyes 1961) or possibly by both single and double restorer genes (multiple genes or complex genes) (Woo et al.

1997)Hairy root cultures have been used as a useful model system to study the production of flavonoid and a variety of other secondary metabolites. For example, Puerariacandolleihairy root cultures were established for the production of isoflavonoid(Medina-Bolivar et al., 2007). In another study, peanut hairy root cultures were developed for testing the bioproduction system for resveratrol.(Udomsuk et al., 2009). Another example involves the pyrrolizidine alkaloids production in hairy root cultures of Echiumrauwolfii(Abd El-Mawla, 2010). Finally, the Taxus media hairy roots that are transformed accumulate the taxane compound (Syklowska-Baranek et al., 2009). Producing phenolic compounds in vitro in hairy root cultures of common buckwheat and tartary buckwheat has been reported (Kim et al., 2009; Lee et al., 2007; Trotin et al., al., 1993).

It is a short-duration crop requiring a moist and cool temperate climate to grow (Joshi and Paroda 1991). Krotov (1963) reports saythat flowering temperatures above 30°C is resulting in fruit desiccation and lowering yield. He also found common buckwheat yield increase with high soil moisture. This shows theincrease in seed size with an increase in soil moisture content. Adequate soil moisture appears to be essential for good yields .wilting occursin common buckwheat very badly and grows very slowly when it is affected by low soil moisture. If buckwheat is subjected to high winds and heavy rains it can lodge badly. Buckwheat does not have a good ability to recover from lodging. The tips of the plants grow upward but the stem often remains in contact with the soil and often can be subject to disease and rot.(Clayton G. Campbell 1997).

ACHIEVEMENTS:

Fagopyrins levelin buckwheat grains is very low and their isolation processis very difficult. It was reported that fagopyrins found in buckwheat can be utilized in the treatment of type II diabetes(Li & Zhang 2001; Bonafaccia et al. 2003; Horbowicz&Obendorf 2005). In New Zealand, biological control Buckwheat is currently being studied and used as a pollen and nectar source. (Berndt LA, Wratten SD, Hassan PG 2002). According to Huff and Carroll (1980) and Sugiyama et al. (1985), cholesterol-lowering effects and a high biological value (BV)are found in buckwheat proteins.protein products addition to diets significantly lowers cholesterol levels in the liver, and gallbladderand suppresses gallstones formation by altering cholesterol metabolism (Tomotake et al. 2002), whereas protein extracts are more efficient in lowering the blood cholesterol level, particularly that of LDL and VLDL (Kayashita et al. 1995; Misawo&Iwao 1996; Tomotake et al. 2006).Honey obtained from buckwheat flowers increases the antioxidative potential of human blood serum and in vitro studies indicated that it protects lipoproteins of blood serum against oxidative processes more effectively than saccharicanalogs (Gheldof et al.

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2003).Buckwheat flour can be also abtained characterized by decreased activities of proteases and α-amylase (Fornal 1999)

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FUTURE ASPECTS:

Studies on genetic polymorphism of buckwheat have a major scope (Huh and Huh, 2000; Ohnishi, 2000), on the molecular basis of buckwheat allergy (Wang et aI., 2000), and on problems that are commonly important in the breeding of buckwheat (Wang and Campbell, 2000;Inoue and Ogiwara, 2001), on the productivity of nectar (Alekseeva and Bureyko, 2000), on quality of buckwheat products (Park et aI., 2000; Ikeda and Asami, 2000).The molecular basis for the technological and textural characteristics of buckwheat products is recently studied and haswider applications in future generations(Ikeda, 1997). In future research at Morden, Canada, for example, investigations will be conducted along four directors; Breeding of reduced allergic protein lines with good agronomic characteristics.

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