

Review Paper

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Multiple Utilization Pathways of Buckwheat: Food, Feed, Medicine and Eco-Tourism

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Abstract Buckwheat is increasingly recognized as a highly multifunctional pseudocereal whose value extends far beyond conventional grain production. This review places particular emphasis on the distinctions between common buckwheat (*Fagopyrum esculentum*) and Tartary buckwheat (*Fagopyrum tataricum*), especially regarding reproductive biology, rutin accumulation, environmental adaptability, and product quality characteristics. Buckwheat possesses a combination of relatively uncommon traits within a single crop species, including adaptability to low-input cultivation systems, broad ecological plasticity, a well-balanced amino acid composition, high concentrations of flavonoids and phenolic compounds, and deep cultural integration within regional food traditions. These characteristics collectively support the extensive utilization of buckwheat in gluten-free and functional foods, livestock feed ingredients and feed additives, phytochemical-based health applications, and flower landscape-oriented agro-tourism systems, while simultaneously contributing to local cultural identity and rural revitalization. At the same time, the development of the buckwheat industry continues to face several important constraints related to breeding systems, production stability, processing technologies, and evidence-based functional evaluation. The present study argues that buckwheat should not be regarded as an isolated niche crop with limited applications, but rather as a strategically integrative crop whose food, feed, medicinal, ecological, and cultural functions can be developed synergistically. Such an integrated utilization model is particularly significant for mountain agriculture, marginal land use, circular bioeconomy development, and regionally differentiated rural development strategies.

Keywords *Fagopyrum esculentum*; *Fagopyrum tataricum*; Functional food; Rutin; Flavonoids; Feed utilization; Pharmacological activity; Agro-tourism; Rural revitalization

1 Introduction

Buckwheat has increasingly been described as a “smart crop” or a “climate-resilient pseudocereal” because of its value in nutritional security, ecological adaptation, and regional economic development. Compared with conventional cereal crops, common buckwheat (*Fagopyrum esculentum*) and Tartary buckwheat (*Fagopyrum tataricum*) belong to the same genus within the Polygonaceae family, but they differ considerably in genetic background, environmental adaptation, and the accumulation of functional compounds (He and Zhou, 2022).

Both common buckwheat and Tartary buckwheat generally show better protein quality and higher mineral contents than many traditional cereal grains. Buckwheat grains are rich in lysine, arginine, and soluble dietary fiber, while common cereals such as wheat and maize are usually deficient in lysine. For this reason, buckwheat has long been considered an important plant resource for improving amino acid balance in human diets (Ahmed et al., 2014). In particular, Tartary buckwheat contains much higher levels of flavonoids, especially rutin, than common buckwheat. Because of this characteristic, Tartary buckwheat has gradually become an important raw material for functional foods and natural antioxidant products.

Compared with major grain crops that often depend heavily on a single commodity market, buckwheat has more diverse utilization pathways. The grains can be consumed directly as food or further processed into functional starch products, flavonoid extracts, and plant-based feed ingredients. Bran and hulls can be used in dietary fiber products, pillow filling materials, and biomass utilization. Buckwheat straw can also serve as roughage for ruminants or as ecological mulching material. Therefore, buckwheat is not only regarded as a crop suitable for