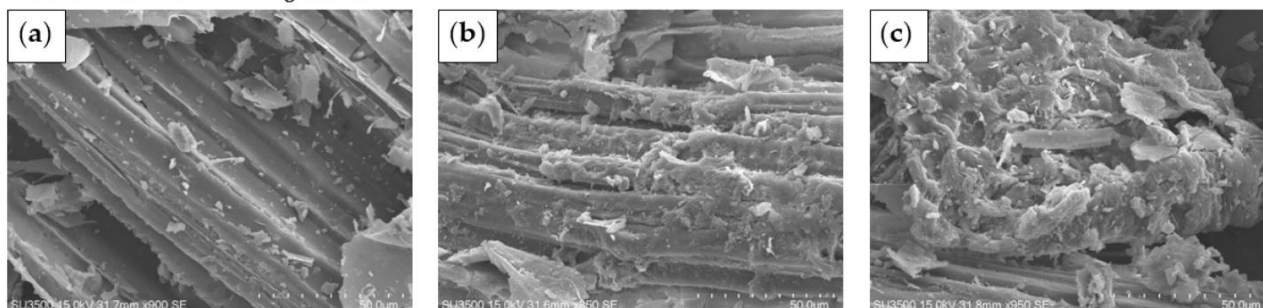


may partly reduce the need for supplemental inorganic phosphorus and exogenous phytase enzymes. This is important because excessive phosphorus supplementation in livestock production contributes to environmental pollution through phosphorus excretion.

Before in vitro rumen digestion:



After in vitro rumen digestion:

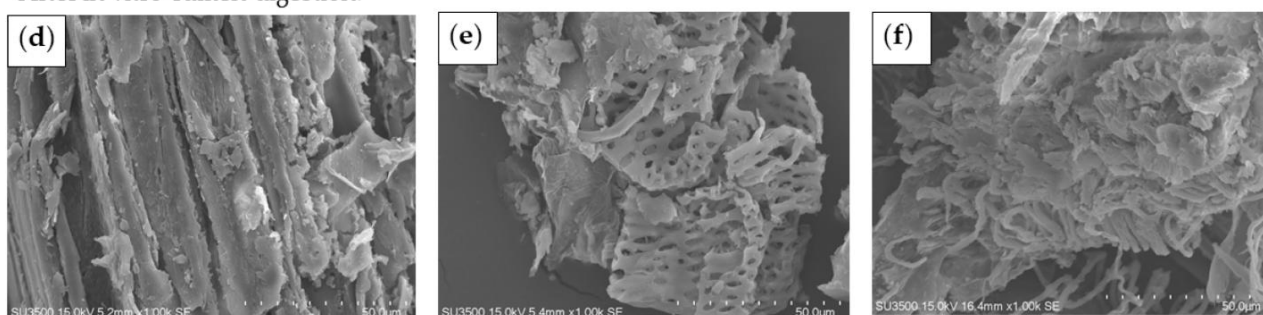


Figure 2 Scanning electron microscopy (SEM) of buckwheat straw before and after in vitro rumen digestion. (a-c) Untreated, once-expanded, and secondary-expanded buckwheat straw before digestion; (d-f) Untreated, once-expanded, and secondary-expanded buckwheat straw after digestion (Adopted from Cao et al., 2023)

6 Medicinal Components and Pharmacological Activities of Tartary Buckwheat

6.1 Bioactive phytochemicals in Tartary buckwheat

Tartary buckwheat (*Fagopyrum tataricum*) contains many functional compounds, including flavonoids, phenolic acids, polysaccharides, proteins and bioactive peptides, as well as D-chiro-inositol-related compounds. Among these substances, rutin is the most representative flavonoid glycoside, while quercetin is commonly regarded as the major active form produced after rutin hydrolysis. Buckwheat protein hydrolysates and peptides have shown potential antioxidant, antidiabetic, antihypertensive, antimicrobial, and anticancer activities. Their structural diversity also provides a basis for the development of functional foods and food-medicine homologous products (Zhu, 2021). Although buckwheat proteins are naturally gluten-free, they may still cause allergic reactions in some individuals. Therefore, medicinal utilization of buckwheat should not focus only on efficacy, but also include safety evaluation.

The concentration of bioactive compounds differs greatly among different parts of the plant. Tartary buckwheat sprouts, flowers, leaves, seed coats, and bran usually contain much higher levels of flavonoids and polyphenols than refined grain flour (Figure 3). Experiments using methanol extracts of Tartary buckwheat sprouts showed that the total flavonoid content reached 98.6 mg/g. Among the six major flavonoids detected, rutin and quercetin were the dominant compounds. Rutin content reached 89.81 mg/g in the crude extract and 31.50 mg/g in sprouts, while quercetin contents were 23.34 mg/g and 8.17 mg/g, respectively (Zhong et al., 2022).

It is important to note that the medicinal composition of buckwheat is highly dynamic rather than chemically fixed. Variety, cultivation environment, germination treatment, thermal processing, fermentation, milling methods, and storage conditions can all influence its chemical profile. In Tartary buckwheat, rutin can be hydrolyzed into quercetin by endogenous rutinoidase during processing. Although quercetin has strong biological activity, its