Innovation in By-Product Processing: A Comparative Study of Chemically Modified Starches from Two Pakistani Rice Varieties

Abeera Moin*, Tahira Mohsin Ali, Abid Hasnain
Department of Food Science and Technology University of Karachi, Karachi, Sindh, Pakistan -75270
*E-mail: abeeramoin@uok.edu.pk

ABSTRACT

Introduction: Broken rice kernels, a by-product of rice milling, are typically processed into rice flour or used as animal feed. However, these fragments hold untapped potential for crafting a variety of higher-value products.

Objective

1. Utilization of broken grains of two major rice varieties of Pakistan i.e. Irri and Basmati.
2. Isolation of starches from broken grains.
3. Chemical modification of isolated starches by using propylene oxide.
4. Determination and comparison of physicochemical properties of starches isolated from broken Basmati and Irri rice.

Methodology

1. Broken grains of Irri and Basmati rice were sourced from Matco Foods Ltd. in Karachi, Pakistan. The starches were extracted from rice grains using an alkaline extraction method (Ashogbon & Akintayo, 2012).
2. The proximate composition of starches was analyzed by using the standard methods outlined by Cereals and Grains Association (AACC 2000).
3. The rice starches were chemically modified through the addition of 10% (v/w) propylene oxide (based on starch weight, db) and degree of modification determined (Moin, Ali, & Hasnain, 2017).
4. The morphology, swelling power, solubility, water retention capacity, paste clarity, pasting profile, gel texture and gelatinization enthalpy was studied (Moin, Ali, & Hasnain, 2016, 2019).

Results: The yield of starch extraction was found to be 56% and 61% for Basmati and Irri, respectively, indicating a higher extraction rate for the Irri variety. Moreover, Basmati starches exhibited a higher amylose content compared to Irri starches. The resulting hydroxypropyl groups constituted 1.06% and 1.16% of Basmati and Irri hydroxypropylated starches, respectively. These values fall below the specified limit for the application of hydroxypropylated starches in food products and drugs, as suggested by the Food and Drug Administration. Significant improvements were observed in peak viscosity, swelling power, solubility, paste clarity, and water retention capacity after the chemical modification of both rice varieties. Furthermore, differential scanning calorimetry revealed a notable decrease in gelatinization temperature and enthalpy following hydroxypropylation of rice starches. Chemical modification also affected the morphology of starch granules, with dents and deformations observed in scanning electron microscopy results. These changes were more pronounced for the Irri rice variety.

Conclusion: Significant changes in the structure and physicochemical properties of rice starches were observed after hydroxypropylation when compared to corresponding native starches.

Keywords: Broken rice, Basmati, Chemical modification, Irri rice.

REFERENCES

1. American Association of Cereal Chemists (2000). Approved methods of the American Association of Cereal Chemists. St. Paul, MN: American Association of Cereal Chemists.
2. Ashogbon, A., & Akintayo, E. (2012). Morphological, functional and pasting properties of starches separated from rice cultivars grown in Nigeria. International Food Research Journal, 19, 665–671.
3. Moin, A., Ali, T. M., & Hasnain, A. (2016). Effect of succinylation on functional and morphological properties of starches from broken kernels of Pakistani Basmati and Irri rice cultivars. Food Chemistry, 191, 52-58.
4. Moin, A., Ali, T. M., & Hasnain, A. (2017). Characterization and utilization of hydroxypropylated rice starches for improving textural and storage properties of rice puddings. International Journal of Biological Macromolecules, 105, 843-851.
5. Moin, A., Ali, T. M., & Hasnain, A. (2019). Thermal, morphological, and physicochemical characteristics of succinylated–crosslinked rice starches. Cereal Chemistry, 96(5), 885-894.