Engineering considerations for designing processing machinery for *Asparagus racemosus* roots

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The present study explores the engineering considerations for designing processing machinery for *Asparagus racemosus* roots, important medicinal plant known for its therapeutic potential thus aligning with achieving the sustainable development goal (SDG) 3 of the United Nations (good health and well-being). Physical, frictional and textural characteristics essential for the design and operation of processing machinery were determined for technological advancements in processing and value addition. The length, width and thickness of whole roots were determined to be 351 ± 56, 5.14 ± 3.95 and 4.93 ± 3.76 respectively, and 253.94 ± 117.30, 6.893 ± 3.705 and 6.39 ± 3.62 mm for trimmed roots. The aspect ratio and sphericity were found to be 35.51 ± 1.12 and 0.093 ± 0.003 respectively, describing an oblong shape. The determined weight variability (8.613–17.432 g), surface area (1529.08–2140.28 mm^2) and projected area (890–3340 mm^2) of the roots influence the ease of peeling and drying process. Bulk density and true density were estimated to be 298.64 and 604.48 kg/m^3 respectively, with porosity of 50.50%. The angle of repose and internal friction coefficient were 33.25 ± 0.303° and 1.03 respectively, whereas external friction against mild steel (0.92) and stainless steel (0.61) helped enhance the understanding of handling characteristics of the roots. The texture of this tuber was found to be softer compared to other tubers, with firmness ranging from 22.43 to 39.34 N and cutting force from 36.18 to 54.79 N. These findings aid in designing efficient processing machinery in alignment with achieving the various SDGs to promote sustainable development and well-being.

Keywords: *Asparagus racemosus*, design considerations, engineering properties, physical characteristics, processing machinery.

herbs'[2]. It is medically important due to the presence of steroidal saponins, the precursor of many pharmacologically active steroids[1,3]. Due to its multiple uses, the demand for *A. racemosus* is constantly increasing[2]. It also contains over 50 organic chemical compounds belonging to various groups, such as glycosides, alkaloids, polysaccharides, mucilage, racemose and isoflavones, all of which have a variety of therapeutic uses[4].

A. racemosus is traditionally used to treat many diseases[5] and plays a significant role in addressing various health concerns, aligning with the sustainable development goal (SDG) 3 of the United Nations (good health and wellbeing). Pharmacological studies revealed the plant to be an anti-stress, anti-diarrhoeal, anti-cancer, antioxidant[6], adaptogenic, antiulcer, anti-anaphylactic, antitussive, antibacterial and radioprotective agent, with the main focus being on its ability to modulate the immune system[5].

In Ayurveda, *A. racemosus* is known for its multifaceted benefits in addressing various aspects regarding women's health. For example, for its ability to enhance fertility by boosting libido, alleviating inflammation in the sex organs and moisturizing dry tissues. Additionally, it aids in promoting folliculogenesis and ovulation, preparing the womb for conception and safeguarding against miscarriages[7]. *A. racemosus* roots have also demonstrated efficacy in treating gynaecological and sexual disorders in both men and women as a spermatogenic drug and natural sex stimulant. The capacity of the roots to increase sperm count, improve motility and boost libido makes them significant for improving semen quality[8].

Different post-harvest operations are performed on medicinal plant roots, including washing, grading, peeling, cutting, drying, packing and further processing which are