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Processing soybeans for food and feed through aqueous extraction: current status and challenges

*Keshun Liu*, USDA-ARS, Idaho, USA

Modern soybean processing is characterized by hexane extraction into oil and defatted meal. Since its development and commercialization, there has been increasing concern with the safety of using hexane and negative environmental impacts of solvent loss. Among several alternatives to the hexane extraction process, aqueous extraction process (AEP) has been extensively studied. Basically, the process consists of particle size reduction, aqueous extraction, and solid-liquid separation into three fractions: a cream layer (sometimes free oil), a liquid extract, and a solid residue. Oil and protein products are subsequently recovered from these fractions. Therefore, AEP differs radically from hexane extraction by using an aqueous system to extract oil and protein simultaneously. This presentation provides a brief overview of AEP with respect to its historical development, current status, and challenges. AEP was first reported in the U.S. in 1950's, and was further developed at the Protein R&D Center of Texas A&M University in 70's and 80's by coupling membrane filtration technology and applying it to several oil-bearing materials, such as coconuts, peanuts, soybeans, and cottonseeds, at pilot scales. For maximizing oil recovery, scientists from many other countries added pretreatments (e.g. extrusion) of raw materials, enzyme assistance during extraction, etc. Between 2005 and 2012, researchers at the Center for Crop Utilization and Research of Iowa State University advanced AEP by fine tuning pretreatments and enzyme selection and by developing a two-stage countercurrent enzyme assisted process. Despite these developments and several apparent advantages (no hexane, low capital investment, and removal of water soluble anti-nutrients), along with recent renewed interest, AEP still has some limitations, including 1) requirements of demulsification to recover oil, 2) treatment of resulting aqueous effluents, and 3) low efficiency of oil and protein recovery. Therefore, further innovative studies are needed to overcome these hurdles and make AEP cost effective for commercialization.