Functional Properties of the Processing Soybeans Products

Sharipov N.Z.	Doctoral student, Bukhara engineering-technological institute, Uzbekistan, Bukhara city
Narziyev M.S.	Candidate of technical sciences, associate professor, Bukhara engineering-technological institute, Uzbekistan, Bukhara city, E-mail: m_narziyev@mail.ru
Yuldasheva Sh.J.	Senior teacher, Bukhara engineering-technological institute, Uzbekistan, Bukhara city
Ismatova N.N.	Assistant, Bukhara engineering-technological institute, Uzbekistan, Bukhara city,

ABSTRACT

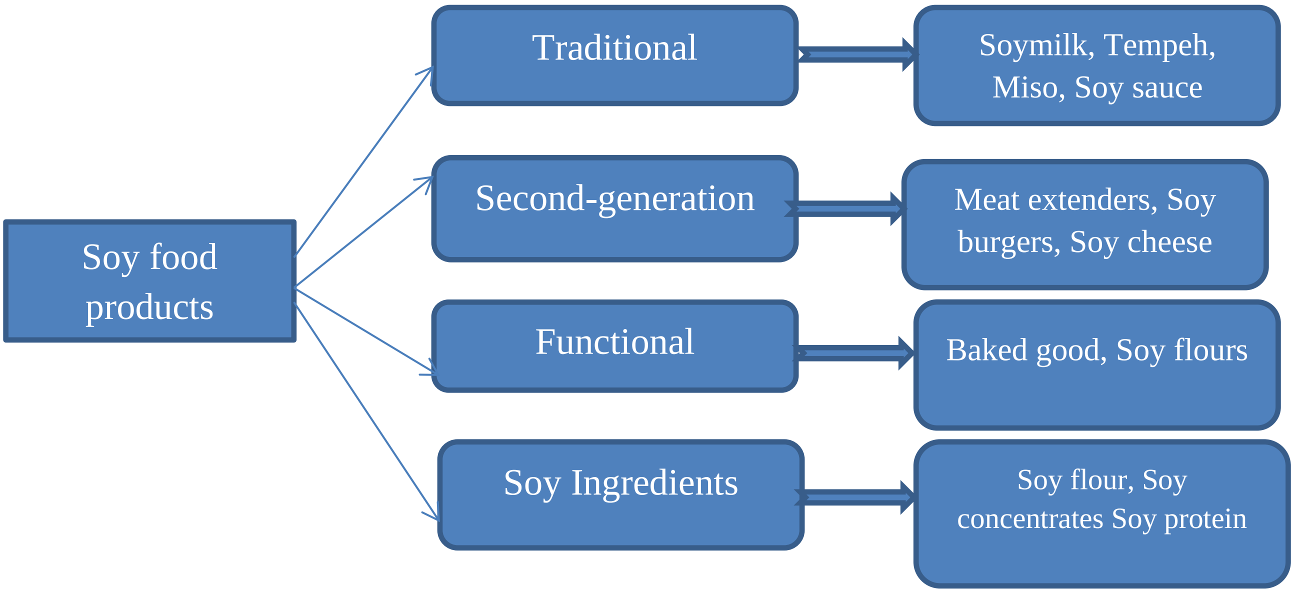
Some functional properties can be interpreted as a result of the thermodynamically favorable protein-water interactions (wettability, swelling, water retention, solubility) or unfavorable (foaming, emulsification). The interactions of protein with water are important in relation to dispensability, water absorption and binding, swelling, viscosity, gelation and surfactant properties as these properties influence the important functions of proteins in meat, bakery and beverage systems. Ease of dispensability or wettability is important in food formulations and is affected by surface polarity, topography, texture and area, and by the size and microstructure of the protein particles. Bound water includes all hydration water and some water loosely associated with protein molecules following centrifugation, ranging from 30 to 50 g per 100 g protein.

Keywords: Products, microstructure, hydrodynamic properties, water solubility, consistency, functional and consumer properties

Soy isolate having the highest protein content among soy protein products has the highest water-binding capacity, approximately 35 g/ 100 g. Soy concentrates contain polysaccharides, which absorb a significant amount of water. Generally, processing conditions can affect the amount of water that can be absorbed; these conditions can be varied to influence how tightly the water is bound by the protein in the finished food product. Water holding capacity is the ability to retain water against gravity, and includes bound water, hydrodynamic water, capillary water and physically entrapped water. Therefore, for the time being, preliminary incomplete peeling of soybean seeds is used using a system of machines for peeling cereal crops, as well as experimental and prototype models of soybean seed peelers. One of which is the hullers that work according to the cotyledon shift method. To do this, use a pair of rubberized (elastic) rolls installed with a certain gap and rotating towards each other at different circumferential speeds. Equipment of this type includes various designs of peeling machines with rubber-coated rollers. The rubber roller is in contact with the seed and when additional pressure is applied to the husk, the stretching of the rubber due to the pressure causes the husk to move relative to each other towards the seed, thereby breaking any bond between the husk and the seed and freeing the seed from the husk. After the seed is freed from the husk, it will be separated on conventional equipment. At the same time, the wear of the rubber surface is high. In the technology of obtaining a soy base, preparing soy protein according to the "Chinese" or "Taiwan" methods, a prerequisite is the removal of the soy shell by the "wet" method. Since moistened seeds are peeling, the use of conventional rolling bearings as roller bearings is impractical due to the likelihood of moisture getting into them. In addition, rubber-coated rollers wear out faster than metal ones, which lead to the need to replace them more often. In this case, large material and energy costs are observed [1].

№	Influencing factors	change interval				
1	Slope angle of the blade,φ (grad.),	30	45	60	75	90
2	Initial humidity W (%)	12	14	16	18	20
3	Drum rotation speed, v_b (rot/min)	500	750	100 0	1250	1500
4	Air flow rate, v_h (m/s)	1	2	3	4	5
5	Primary product consumption G (kg/s)	0,01	0,015	0,02	0,025	0,03

The process of separating from the bark was also studied for local soybean seeds. The results obtained show that the angle of inclination of the blade separating from the soybean husk at an angle of 45^0 is 0.94. In addition, the factors influencing the separation process were determined by the parameters of humidity 14%, the speed of rotation of the drum 1250 rot/min, the speed of air flow in the separation 2 m/s. In addition, the slope angle of the blade, product moisture, drum rotation speed, air flow rate, and the effect of the initial product consumption on the proportion of unripe seeds were also studied as output parameters. The amount of water associated to proteins is closely related with its amino acids profile and increases with the number of charged residues conformation, hydrophobicity, pH, temperature, ionic strength and protein concentration. Defatting increases the protein solubility and water and oil absorption capacities of the meals. Germination, fermentation, soaking or thermal treatments (toasting/autoclaving) significantly improves water absorption capacity. Proteins swell as they absorb water and it is an important functional property in foods like processed meat, dough and custards where the proteins should imbibe and hold water without dissolving and concurrently impart body, thickening and viscosity. Viscosity and swelling are closely related important properties in processed meats. Factors which affected swelling also influence viscosity; protein concentration, pH and temperature positively affect swelling and viscosity whereas sodium chloride depresses both. Protein solubility is influenced by the hydrophobicity/hydrophobicity balance, which depends on the amino acid composition, particularly at the protein surface. Solubility, hydrodynamic properties, hydrophobicity and microstructure of proteins have been reported to play an important role in the rheological properties of proteins. Apparent viscosity of soybean isolates depends on interaction between soluble and insoluble proteins with water and between the hydrated particles. Due to the increased interactions of hydrated proteins, the water absorption and swelling, viscosity increases exponentially with protein concentration [2].



Knowledge of the viscosity and flow properties of protein dispersions are of practical importance in product formulation, processing texture control and mouth feel properties and in clarifying protein-protein interactions and conditions affecting conformational and hydrodynamic properties. Important properties of foods involve the interaction(s) of proteins and lipids, e.g. emulsions, fat entrapment in meats, flavor absorption, lipoprotein complexes in egg yolk, meats, milk, coffee whiteners, dough, and cake batters. Emulsions and foams are two phase systems commonly found in food systems, whose formation is significantly affected by protein surface activity. Emulsions are generated by mixing two immiscible liquids e.g. oil and water. The liquids are immiscible because of their relative polarities. When liquid of low polarity such as fat is mixed with water strong driving forces limits the contact between the two liquids resulting to phase separation. Droplet size of emulsion significantly affects the stability of emulsions; emulsions with precisely controlled droplet size exhibit better stability. Reduction in droplet size also improves stability of an emulsion to separation due to gravity. The goal in food processing is to stabilize the emulsion thereby giving it a reasonable lifetime. The dispersed system can be stabilized against coalescence and phase separation by adding a component that is partially soluble in both phases. Such components are phospholipids emulsifiers which when mixed with lipid in an aqueous environment; the fatty acid portion of the molecule is inserted into the oil phase, while the phosphate ester head group remains in contact with the aqueous phase.

We use an auger supplier to deliver local soybean meal to the laboratory unit.

Product delivery control is adjusted by changing the auger speed. Product delivery productivity (kg / h) is determined by the following formula [3]:

$$Q = 4{,}7 \cdot 10^{-2} Dtkn\gamma, \qquad (1)$$

where D- diameter of auger, m;
t-step of screw, m;
k- replenishment coefficients; k=0,8-1,0;
n- the rotational frequency of the auger, rot/min;
γ- volumetric mass of the product, kg/m^3.

From formula (1) it is possible to determine the rotational frequency of the auger, which ensures the delivery of the product required for the experiment [4]:

$$n = \frac{Q}{4{,}7 \cdot 10^{-2} Dtk\gamma} \qquad (2)$$

The required rotational frequency of the auger is achieved by changing the voltage of the auger to the electric motor.

The result is that the two immiscible phases are not in contact with each other and the total energy of the system is lower. Emulsifiers or foaming agents therefore reduce the interfacial tension and help to stabilize the oil-water and air-water interfaces.

Separation coefficient as the sought objective functions K_a,(%) and the proportion of unbroken seeds in the total composition of the sown X_{ug} (%) marked.

The effectiveness of peeling is evaluated by two indicators - quantitative and qualitative. The quantitative indicator is the coefficient of peeling, expressed as a percentage [5]:

$$K_a = (H_1 - H_2) \times 100 / H_1, \quad (3)$$

where H_1 and H_2 are the content of found grains in the product entering and leaving the machine, %.

In decreasing the interfacial tension of emulsions low molecular weight surfactants phospholipids, mono and triglycerides or mono estates are more effective than high molecular weight ones proteins and hydrocolloids. Despite the lower efficiency of proteins the emulsions and foams formed with proteins are more stable, hence proteins are preferred 352 Soybean - Biochemistry, Chemistry and Physiology over low molecular weight surfactants for emulsification purposes in foods. Surface activity of proteins is related to their conformation and ability to unfold at interfaces determined by molecular factors flexibility, conformational stability, distribution of hydrophilic and hydrophobic residues in the primary structure and external factors pH, ionic strength, temperature, possible competitive adsorption of other proteins or lipids in the interface. Highly insoluble proteins are not good emulsifiers as they can generate coalescence. Emulsion stability is not only influenced by the presence of salts and pH, but also by several physical interdependent processes such as cream formation, flocculation or aggregation and coalescence resulting in phase separation. Soy ingredients that have unique functional applications in bakery products include soy flours, soy grits, soy protein concentrates, soy protein isolates, textured soy protein, soy beans, and soy germs. Soy bean is obtained by toasting and grinding the seed coat portion of the soy bean. Soy germ comprises 2% of the total soybean and is used in baked and extruded products as well as in cereal-based products as adjunct to other soy ingredients to increase is flavone levels. Inclusion rates are usually 1 to 2% of the total formulation of the product because of its high is flavones content. The technological process of soybean processing includes the following stages: reception, purification from impurities and storage of soybeans; peeling soybeans; extruding; extraction of oil to obtain soybean oil and cake; settling and filtering soybean oil to obtain purified soybean oil; grinding and cooling of soybean cake to obtain semi-skimmed soybean meal; extruding soy flour to obtain textured soy protein. Grain peeling is one of the main operations, the efficiency of which largely determines the yield and quality of oil and feed meal. The capacity of proteins to form stable foams with gas by forming impervious protein is an important property in some food applications including angel and sponge cakes. Soy protein products differ in their foaming ability, with soy isolates being superior to soy flour and concentrates. Soy protein foaming ability is closely correlated to its solubility. Soy proteins addition to wheat flour dilutes the gluten proteins and starch while exhibiting a strong water-binding power that provides some resistance to dough expansion, the effect being proportional to quantity of soy flour [6].

The water-binding power of soy flour is related to its high water absorption capacity, 110% by weight in defatted product. That is defatted soy flour will absorb an amount of water equal to its weight when mixed with wheat flour to normal dough consistency. However, with full-fat flour, no measureable increase in dough absorption results from normal use levels of the soy product. Water holding capacity of protein is very important as it affects the texture, juiciness, and taste of food products and in particular the shelf-life of bakery products. The purpose and significance of hulling soybean seeds is as follows: if the oil is made with husk, the husk not only does not release oil, but also absorbs fat and remains in the cake, reducing the oil yield. Impurities such as pigments on the husk will be transferred to the crude oil during the oil making process, making the color more intense and reducing the quality of the crude oil. Soy protein ingredients are important in determining the quality of the product as well as facilitating such processing requirements as in improving machinability of cookie dough for instance. The extent of heat treatment during processing determines the use of soy proteins in bakery products. Soy proteins are rapidly insolubilized by heat, moist heat in particular during processing. However, heat is necessary during soy protein production as it is needed to desolventize, inactivate anti-nutrient compounds and to improve soy flour flavors. On the other hand, non-heated soy flours have bitter, beany flavor and limited applications while containing high activity.

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