Processing of Soybeans to Improve Palatability and Digestibility of Soy-Based Foods

Infrared heat treatment (micronization) of intact soybean seed can effectively reduce the undesirable beany flavour and trypsin inhibitor levels in soy-based food products, improving palatability and digestibility.

PRODUCTS MADE FROM soybean meal have been linked to reduced risks of cancer, osteoporosis, renal disease and heart disease. These health benefits may be attributed mainly to soy protein. Despite these benefits, there are some limitations to soy-based products such as a beany flavour that consumers deem undesirable and trypsin inhibitors that interfere with the ability of trypsin to digest protein in the diet.

The beany flavour has been linked to volatile flavour components in soy products. These volatile components result from the oxidation of fatty acids by the enzyme lipoxygenase. Different approaches have been examined to reduce these volatiles, including heat treatment. However, heat can change the way soybean protein behaves in food products. For example, it can reduce the level of protein in soymilk.

The objective of this study was to reduce the undesirable beany flavour and trypsin inhibitor levels in soybeans without affecting protein quality and its functioning in food products. A variety of treatments, such as micronization (infrared heating), ethanol extraction and treatment with the enzyme alcalase, were used alone or in combination to test this.

Micronization treatments (no heat, 100°C heat and 135°C heat) were used on whole soybean seeds at 13% moisture content. The seeds were then de-hulled and milled into flour. The flour was defatted with hexane to mimic industrial oil removal and the fat content was reduced from 25% to below 3%. Three ethanol treatments (0, 65% or 85% ethanol washes) were then applied to remove the lipid component further. The final treatment on the flours was hydrolysis with the alcalase enzyme, which breaks down protein.

Micronization alone effectively reduced trypsin inhibitor activity (TIA). TIA was reduced by 50% at 100°C and reduced by 80% at 135°C. In most cases, the ethanol treatment did not reduce TIA. It actually increased TIA in non-micronized soybean flour samples. Alcalase treatment results were more variable. Alcalase reduced TIA in the non-micronized soy flour samples, had no effect on the samples micronized to 100°C and those treated with ethanol, and increased TIA in flour samples that were pre-treated with heat at 135°C. While alcalase was able to reduce TIA in unheated samples, there was no benefit when combined with a heat treatment.

Lipoxygenase (LOX) activity, related to the undesirable beany flavour, was very sensitive to heat. After micronization at 135°C, 99.6% of the LOX was inactivated. In addition, LOX activity was not found in samples treated with ethanol or alcalase. This means that all three methods show promise for reducing the volatiles that cause the beany flavour.

Overall, a moist heat treatment like micronization applied to intact soybean seed is the most effective way to reduce both beany flavour and trypsin inhibitor levels in soy-based food products. Improved palatability and digestibility of these products will then increase the potential for uptake and demand. The next step of this research would be a sensory study to test these findings on consumer perception of beany flavour in soy products.

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