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Edamame Processing: What Do I Need to Know?

Authored by Renata Carneiro, Doctoral Student, Food Science and Technology, Virginia Tech; Dajun Yu, Doctoral Student, Food Science and Technology, Virginia Tech; Haibo Huang, Assistant Professor, Food Science and Technology, Virginia Tech; Sean O'Keefe, Professor, Food Science and Technology, Virginia Tech; and Susan Duncan, Professor, Food Science and Technology, Virginia Tech

Edamame, also known as vegetable soybean, is a high-value and nutritious specialty crop whose consumption has been increasing in the United States. In Virginia, edamame has been suggested as an alternative crop to replace tobacco production, which has decreased over the past decades. Due to edamame's short harvest period, proper processing and storage are essential to ensure high quality product availability all year long. Food processing technology is broadly applied to edamame as well as other vegetables and fruits in order to extend shelf life, reduce post-harvest losses, and improve food diversity. In addition to product availability and convenience, proper edamame processing can ensure high-quality, safe products for U.S. consumers. This publication will cover important aspects of edamame processing in order to inform and guide growers and food processors interested in this vegetable crop.

Producing High-Quality Edamame

In the food industry, blanching, freezing, and cold storage are common preservation methods applied to edamame in order to extend its shelf life (Xu et al. 2012). Saldivar et al. (2010) reported that fresh edamame pods stored at 25 degrees Celsius (°C) and under open air (not in a controlled or modified atmosphere) quickly changed color from green to yellow. By the sixth day of storage, beans were completely yellow and pods were dry and hard (changes similar to those observed in natural seed maturation). Flavor and appearance of fresh edamame can be retained only for a short time even under proper storage conditions, and low temperature has been shown to be more important than controlled atmosphere to preserve the nutritional and sensory attributes of fresh products (Saldivar et al. 2010). During storage, vitamin C can decrease significantly, and unblanched samples can quickly develop strong rancid and grassy odors (Sheu and Chen 1991). Researchers have discovered that higher yielding edamame lines tend to have a longer shelf life than high-sugar cultivars (Johnson, Wang, and Suzuki 1999). For frozen storage of edamame, samples must first be blanched to destroy enzymes that would otherwise quickly cause flavor deterioration.

Edamame Processing Steps

Overall, post-harvest processing steps can affect food characteristics and could impact food acceptability. For edamame, higher quality is achieved when pods are cooled and blanched within a short time after harvest; thus, timesaving procedures are of extreme importance and are a major concern for edamame processors (Masuda 1991). See figure 1 for a flowchart of the process of freezing edamame process.

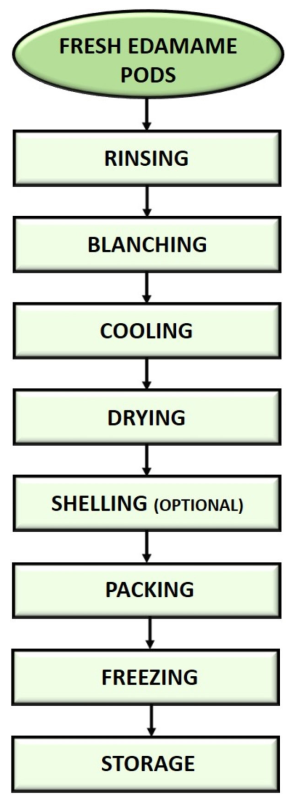

Figure 1. Frozen edamame process flowchart.

Rinsing

Rinsing is often the first processing step for raw edamame pods (fig. 2). It helps remove dirt and debris from the vegetables but does not contribute significantly to microbial reduction. Frozen edamame is sold in pods or shelled, so manual or mechanical shelling is usually an optional step for edamame processors. Nevertheless, when combined with the initial rinsing step, shelling reduces 1-2 log colony-forming units per gram (CFU/g) of surface microbial contaminants (total microbial load, yeast and mold, and total coliform counts) in unblanched edamame (Pao et al. 2008).

Figure 2. Fresh edamame pods before rinsing step.

Blanching

Blanching is the most important processing step of frozen edamame. Blanching inactivates enzymes, avoids oxidation and unwanted tastes, and contributes to microbiological quality and safety (Konovsky, Lumpkin, and McClary 1994; Pao et al. 2008; Sheu and Chen 1991; Carson et al. 2011). Figure 2 illustrates fresh edamame pods being processed at the Virginia Tech Food Processing Pilot Plant. In this example, edamame pods were placed in metal baskets in a steam kettle to be blanched in boiling distilled water (98°C ± 1°C) for one minute. In sequence, baskets were immediately placed in a cooling bath (4°C ± 1°C) for two minutes to avoid overheating, and then pods were dewatered, packed, and stored.

Boiling can induce tissue and cell rupture, which — when accompanied by freezing — can result in undesirable flavor because of lipid peroxides, since cell disruption allows oxidative enzymes and lipid substrates to meet (Masuda 1991). Therefore, blanching without sufficient heat treatment would lead to a worse product quality compared to a nonblanched, frozen product. Several studies have recommended the use of a high temperature and short time for blanching vegetable soybeans (Sheu and Chen 1991; Song, An, and Kim 2003; and Xu et al. 2012). Blanching conditions of one minute at 100°C with pods and 50 seconds at 95°C without pods produce a better product based on the results of quality analyses and sensory evaluation (Sheu and Chen 1991). Blanching fresh, in-pod edamame in hot water (98°C ± 2°C) for one minute is also an effective way to reduce background microflora and eliminate potential microbiological hazard (e.g., Escherichia coli and Listeria spp.; Pao et al. 2008). An additional example of blanching parameters for edamame processing include the work of Xu et al. (2012) They reported that blanching in-pod edamame for 2.5 minutes or longer in hot water (100°C) effectively reduced peroxidase enzyme activity (98%) and microbial count (total yeast, mold, and coliform bacteria; ≤1 log CFU/g).

Figure 3. Blanching step (boiling water at 98°C ± 1°C for one minute) in edamame processing at the Virginia Tech Food Processing Pilot Plant.

Blanching can also affect sensory characteristics of edamame, such as appearance and texture. The green color of edamame blanched for one minute was reported to be more intense than that of raw edamame. The texture (hardness) of edamame increased after one minute blanching of pods, but this increase was less significant than that produced after a longer (five minutes) blanching (Mozzoni et al. 2009). Saldivar et al. (2010) concluded that loss in soluble sugar content was higher in water blanching than in steam blanching at 100°C for 10 minutes due to leaching. Mozzoni et al. (2009) reported that edamame processing time using steam-jacketed kettle water blanching did not affect monosaccharides, oligosaccharides, and iron content. However, Song, An, and Kim (2003) reported losses of mono- and disaccharides (sucrose, glucose, and fructose) increased with a longer blanching time, but the content of amino acids was not significantly affected. Blanching edamame seeds in their pods could reduce losses of sucrose and soluble sugar content, but no differences were observed for trypsin inhibitor activity, color, or texture when edamame blanched in pods was compared to edamame blanched as shelled beans (Mozzoni et al. 2009; Saldivar et al. 2010). Additionally, Mozzoni et al. (2009) reported that boiling edamame for five minutes was enough to achieve commercial inactivation of trypsin inhibitor activity.

Cold and Frozen Storage

After analyzing several samples of edamame (variety Asmara) blanched under different conditions and stored refrigerated (4˚C, ≤12 days) and frozen (−20˚C, one week to three months), Xu et al. (2012) suggested blanched edamame could be refrigerated for seven days without encountering excessive microbial growth. The authors reported that frozen storage did not have a significant effect on edamame's green color but contributed to decreased hardness (61%-67%) of edamame beans. In addition, Saldivar et al. (2010) reported sugar content of blanched edamame did not change significantly during six months of frozen storage.

Conclusions

Blanching before frozen storage of edamame is critically important for storage and quality. Blanching destroys enzymes that could cause flavor deterioration and lower microbial load. Boiling-water blanching for several minutes is adequate for high-quality edamame, although steam blanching could cause less nutrient leaching and loss.

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