

Continuous Flow Microwave Quality Advantages

Nutrient, Color, and Flavor Preservation Confirmed Through Third Party Testing of Commercialized Products



Microwave energy gently heats pumpable foods, such as soups, hummus, beverages, and sauces to rapidly achieve the temperatures required for food safety. By reducing the time to achieve that temperature, microwave technology offers quality advantages in color, flavor, aromas, textures, and nutrient retention. Systems can be scaled from 1 lpm - 100 gpm to accommodate both small-scale and large-scale commercial manufacturing.

Confirmed Through Third-Party Testing:

Products were made using continuous flow microwave thermal processing and tested for quality on the basis of nutrient, color, and sensory characteristics. All products were commercially sterile with a 9-12 month shelf life.

Nutrient Retention:

A series of nutrient-rich beverages were compared before and after rapid thermal processing into shelf stable packaged goods. The samples were tested at a third-party laboratory. Figures 1 and 2 show that post-processing samples retained nearly all of their sensitive nutrients, which typically degrade with heat, light and oxygen. In Figure 1, the ascorbic acid retention was measured by HPLC. The total antioxidant capacity was measured using the ORAC (Oxygen Radical Antioxidant Capacity) assay. The total monomeric anthocyanin content was measured using the pH differential method. The total carotenoid content was measured using a HPLC. In Figure 2, a separate set of fortified fruit purees were tested at a third-party lab using methodologies approved by A2LA, NVLAP, AAR and AIHA, which are accepted for use in nutritional labeling.

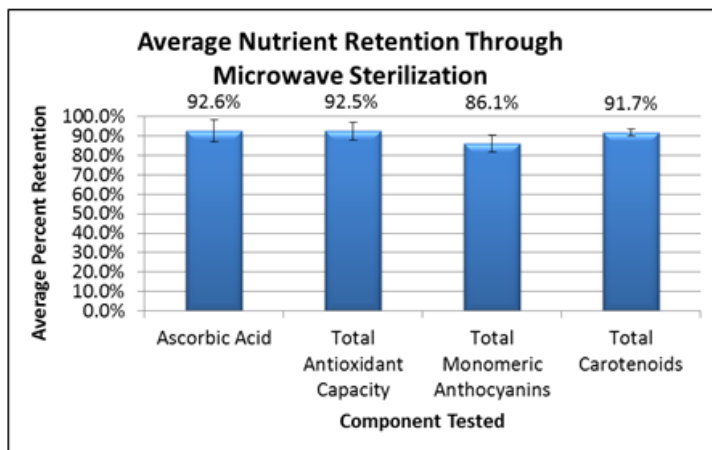


Figure 1. Shown is the percentage of *different nutrients* retained in a nutrient-fortified fruit puree after thermal processing for shelf stability.

Nutrient	Nomatic™
Retinyl Palmitate	103%
Ascorbic Acid	100%
Thiamin	101%
Riboflavin	96%
Niacinamide	99%
Pantothenate	99%
Pyridoxine	102%
Biotin	98%
Folic Acid	103%

Figure 2. The percentage of *vitamins* retained in a nutrient-fortified fruit puree after thermal processing for shelf stability.



Color Retention:

Color retention was tested between pre- and post- processed products in-house on a Konica Minolta Color Reader with an L*a*b* scale. The ΔE value was calculated to quantify the difference between the two samples with a value greater than 2.3 considered visible to the eye. For the majority of products there was no visible difference found between the pre- and post-processed samples.

Table 1. Color changes between pre- and post-processed products measured as L*a*b*

Sample Name	L* (Pre)	L* (Post)	a* (Pre)	a* (Post)	b* (Pre)	b* (Post)	ΔE Value
Berry Chia Smoothie	34.6	35.3	11.0	10.7	-0.7	0.0	0.7
Berry Hibiscus Smoothie	37.4	37.4	11.0	10.3	1.0	1.6	0.9
Green Smoothie	44.3	43.6	-0.8	0.4	15.8	15.3	1.5
Spicy Mango Smoothie	48.9	48.3	5.2	5.1	28.7	27.4	1.4
Plain Applesauce	48.8	50.1	-3.8	-3.2	14.1	13.5	1.5
Raspberry Puree	32.7	32.5	19.2	18.6	3.6	3.1	0.8
Strawberry Banana Smoothie	46.4	46.3	14.1	13.3	5.4	6.9	1.7
Superfood Smoothie	39.7	41.2	-1.9	2.1	11.2	13.5	4.9

ΔE values less than 2.3 are considered non-visible.

Flavor Retention:

Shelf stable finished goods of three juice smoothie products were submitted to a third party sensory preference panel along with their flash-pasteurized, refrigerated leading competitors. The results of this sensory study showed no significant difference between microwave shelf stable juices and the market leading refrigerated products in terms of freshness perception, purchase intent, and overall preference.

Table 2. Sensory results of shelf stable juice smoothies vs. leading refrigerated competitor

Sample Pairings		Overall Liking (1-9)	Purchase Intent (1-5)	Fresh Taste		
				Not Fresh Enough (%)	Just About Right (%)	Too Fresh (%)
Pair 1	Strawberry Banana	6.43a	3.28a	28.6a	70.5a	1.0a
	Leading Refrigerated Competitor	6.52a	3.48a	21.9a	75.2a	2.9a
Pair 2	Berry Chia	5.50a	2.84a	31.4a	66.7a	1.9a
	Leading Refrigerated Competitor	5.82a	3.05a	30.5a	67.6a	1.9a
Pair 3	Superfood	4.41a	2.35a	38.1a	53.3a	8.6a
	Leading Refrigerated Competitor	4.64a	2.39a	33.3a	58.1a	8.6a

Results are based on a 3rd party preference test of 106 people. Results between pairs, followed by the same letter for the same attribute, are considered to be not significantly different.

Summary

Continuous Flow Microwave Processing has been shown to be an effective sterilization method for sensitive foods by retaining nutrients, color, and flavor. Nutrients are preserved at 86-100% of the unprocessed value of twelve different nutrients. Color was preserved for the majority of products tested such that there was no detectable color difference to the human eye. Organoleptic properties were preserved such that the sterilized shelf stable products were found to have no significant difference from the flash pasteurized products. The results of these studies highlight the high product quality that may be obtained through use of a continuous flow microwave system to sterilize food products.