Pasteurisation: *Food safety for nuts*

How does food safety apply to nuts? In this article, we look at the regulatory update on food safety in the tree nut industry — from risk assessment to validations, and review current pasteurisation technologies.

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Food safety is a top concern for health agencies and retailers in the food industry as it is costly when there are product recalls and food borne illness outbreaks. For tree nuts, which are promoted as being highly nutritious with natural health benefits, these concerns are particularly relevant. Environmental contaminants including pathogenic microorganisms E. Coli, listeria, and salmonella can be found on nuts. The pathogens survive very well on raw nuts, from the harvest in the orchard through processing and into stores and pantries for the duration of their long shelf life. A retail survey conducted between 2015 and 2017 in US supermarkets on cashew, walnut, hazelnut and macadamia showed a prevalence level 0.5% to 5% salmonella positive samples in consumer packs.

The contaminants, which in nuts are sparsely distributed and present at low levels, are nonetheless dangerous and can cause serious diseases. Because of the sporadic nature of this contamination, sampling programmes are inadequate to ensure product safety as only information about the status of the sample is provided and not for the remaining product in the lot. A validated pasteurisation process is the only effective preventive control for salmonella as it eliminates any pathogen in the entire load. Several pasteurisation technologies specifically adapted to nuts are available on the market.

PASTEURISATION: THE PREVENTIVE CONTROL

Nuts are processed at harvest

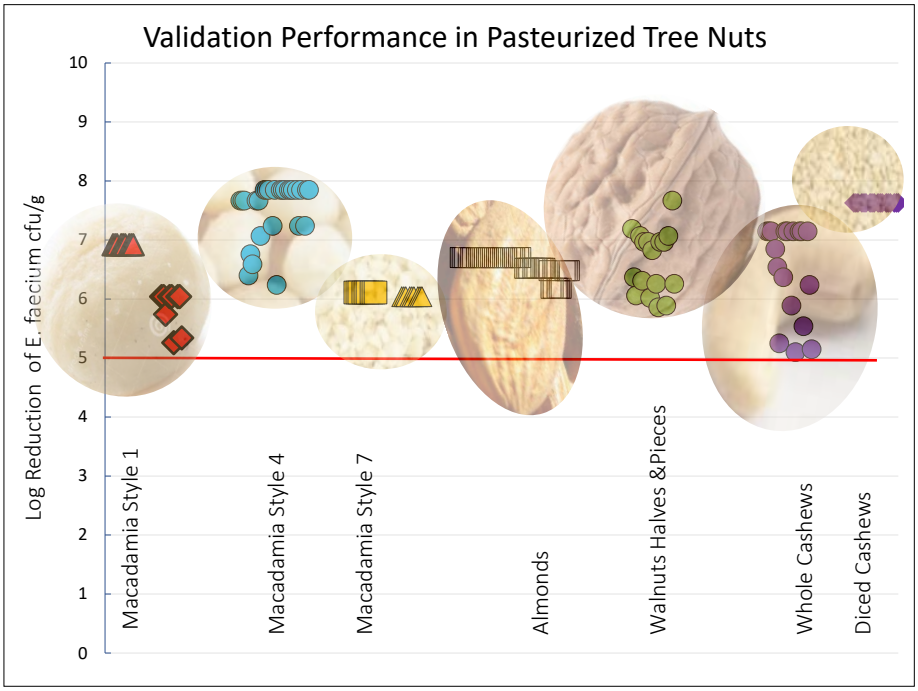
Processes	Treatment T°	Time (minutes)	Process	Reduction	Sensory
PPO Propylene Oxide	51°C	4 hours *	Dry	>5log	Raw
Blanching	88°C	2	Wet	>5log	Peeled
Oil roasting	127°C	2	Dry	>5log	Roasted
Dry Roasting	148°C	9	Dry	4log	Roasted
Ambient pressure steam/moist air	100°C		Wet	4log	Raw
Napasol dry saturated steam	88°C	9	Dry	>5log	Raw

Table 1: Summary of treatment parameters for validated pasteurisation processes for almonds. Source: Almond Board of California for blanching, roasting and PPO. Propylene oxide is a chemical compound widely used in the US but is not permitted in the European Union. PPO requires four hours of treatment and two- to four-days of ventilation. Ambient pressure steam and moist air treatment processes have been validated for a 4-log reduction but the time parameters have not been published. Napasol's dry saturated steam process delivers a 5-log reduction, maintaining the raw characteristics of the nuts without the need for drying*

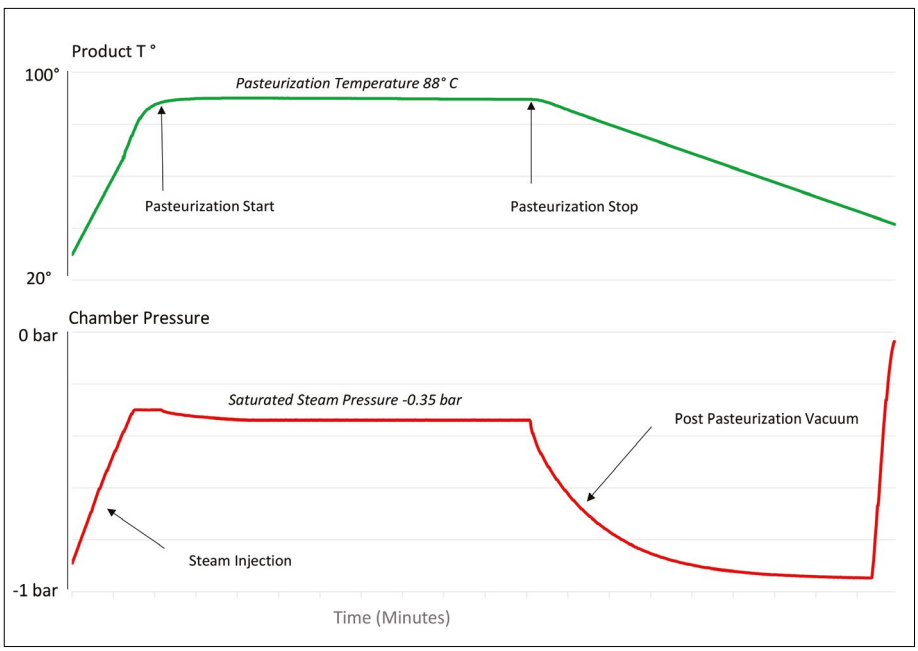
and shipped to consumer markets throughout the year. Major producing countries, such as Africa, Australia and the US, ship large portions of their yearly production to destinations around the world. Disruption to the supply chain is extremely costly when positive salmonella samples are found. Far-reaching consequences include the costs for holding and testing for positive release procedures before shipping, rejection of containers at ports of destination, delivery delays, additional regulatory scrutiny, and damage to the reputation of the product category and the brand. Considering these risks there is no excuse for not implementing preventive controls.

In the US, mandatory measures have been in place for pasteurising almonds since 2007. Between 2017 and 2019, the U.S. Food and Drug Administration published data on risk assessments that were conducted for a basket of tree nuts: almonds, walnuts, pistachios and pecans. In the studies, the risk of illness per serving per year was estimated based on prevalence data and consumption patterns. The level of preventive control necessary to reduce the risk to an acceptable level was modelled. For instance, the simulation showed that a 10'000-fold (4-log) reduction of salmonella would be necessary to reach that goal. The assessment further modelled the increase in the level of risk associated with an adverse event such as a wet crop or processing delay for almonds, pistachios, and pecans. In such a case, a 100'000-fold (5-log) reduction would be necessary to reach an acceptable risk level. This 4-log to 5-log reduction performance on raw nuts is not always achievable with the current technologies in the market.

Pasteurisation is the only preventive control for salmonella. Most pasteurisation methods are based



Graph 1: Validation data for macadamias, almonds, walnuts and cashews samples pasteurized at 15 different pasteurisation plants. The plants were validated for whole nuts and nut pieces. Each data point corresponds to the reduction in enterococcus faecium (a salmonella surrogate approved for in-plant validations) in a nut sample inoculated to levels up to 100'000'000cfu/g (8log). In all cases, the reduction is superior to 100'000 fold (5log) and is obtained at temperatures below 90°C, with between six- and nine-minutes pasteurisation times specific to each nut



Graph 2: The plot of chamber pressure and product temperature during the Napasol saturated steam pasteurisation process. Records are from a 6-bin Napasol pasteurisation line with a load of 4800 kg of walnuts. Walnuts are loaded in bulk bins of 800kg each. Red: chamber pressure. As steam is injected in the chamber, pressure rises from near-absolute vacuum (-0.950 bar) to -0.350 bar. Green: product temperature. Product temperature rises as the injected steam penetrates the load until the pasteurisation temperature of 88°C is reached. Following nine minutes of pasteurisation, the vacuum removes any residual steam and cools down the product. The pasteurisation ends with filtered air released into the chamber until ambient pressure is reached

Image 1: A 2-bin Napasol pasteurisation line. On the left is the preheat chamber in the middle the pasteurisation chamber. On the right is the cooling platform. Auxiliary systems are laid out on a mezzanine platform.

Photo credit: Sunshine Foods, China

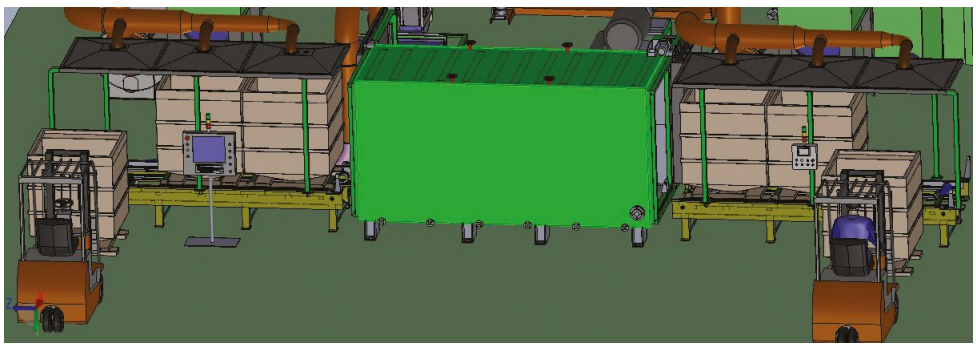


Figure 1: Napasol 3-bin pasteurisation plant layout drawing. From left to right: the preheat platform, the pasteuriser and the cooling platform. Bins are loaded on the raw room side of the preheat platform and automatically move through the line until they are removed after cooling on the clean room side. This plant delivers 3 tons/hr of pasteurised cooled nuts to the packing line

on thermal treatments, in which the heat denatures enzymes that insure vital metabolic function. Different thermal pasteurisation technologies have evolved from existing continuous processes such as roasting and blanching. In the first case, moisture is added to the hot air, whereas in the second wet steam is applied followed by a drying step to remove the added moisture. However, Napasol has developed a dry saturated steam process which combines vacuum and steam to achieve a highly effective reduction without needing a drying step (Table 1).

THE NAPASOL TECHNOLOGY

Nuts are transformed in continuous pasteurisation processes particularly at higher temperatures or with wet steam, the added moisture results in colour or flavour change and skin lifting. Unlike continuous processes where wet steam is applied at ambient pressure, Napasol pasteurisers run batches through a chamber where the pressure can be controlled. Dry saturated steam is applied at relatively low temperatures in a partial vacuum maintaining the nuts' colour, texture, and flavour.

Napasol has established the superior performance of this dry saturated steam vacuum process for the pasteurisation of nuts with lines validated for 5-log reduction in plants around the world. Validation data is shown for several nuts and nut sizes in Graph 1.

Seen in Graph 2 is the pressure and temperature parameters applied in the Napasol pasteurisation process. In the pasteuriser, a deep vacuum is used to remove all air from the load and chamber. High pressure steam is introduced in the chamber and spreads evenly into the load, raising the product temperature. Once the pasteurisation temperature is reached, saturated steam conditions are maintained by controlling the pressure.

The Napasol pasteurisation lines consist of three sections: preheating, pasteurisation and cooling (Figure 1). Each section is modular and can be built on a 1-bin footprint for smaller processors, up to a 6-bin footprint for larger throughputs. Figure 1 shows a 3-bin unit configuration. The product is loaded into the stainless steel bins and moves automatically through the sections of the line without any scuffing, breakage or dust.

Image 1 shows an overview of a 2-bin Napasol pasteuriser. Preheating, cooling fans and other auxiliary systems were placed on a mezzanine above the pasteurisation line to minimize the plant's footprint.

Nuts are frequently consumed raw and a suitable pasteurisation process that maintains the colour, flavour and bite of the product is desired. Adapting existing technologies such as roasting as a kill step frequently requires over roasting the product in order to achieve validated pasteurisation parameters. Continuous wet steam processes necessitate a drying step to remove the added moisture. This is not required with the Napasol dry saturated steam process which delivers a higher level of food safety while maintaining the qualities of the raw nuts. Trading nuts without a pasteurisation step carries inherent risks associated with environmental contaminants. Pasteurisation guarantees market access and ensures a supply of safe nuts for the consumers. **FBA**