

FRUIT & VEGETABLES



6

YOUR CHALLENGES

- Prevent enzymatic browning and ripening
- Microbial decay
- Long-lasting freshness

CLEAN-LABEL HIGHLIGHTS

- Plantéria® CF Citrus extract
- Proteria® Fermented sugar
- Guardox™ AE Acerola extract
- Antibräun™ Citrus-lemon extract

KEEPING A LONGER FRESHNESS WITH ORGANIC EXTRACTS

It is also estimated that about 20% of all fruits and vegetables produced is lost each year due to spoilage. Harvested fruits and vegetables are metabolically active, undergoing ripening and senescence processes must be controlled to prolong postharvest quality. While fresh-cut fruits and vegetables have a shorter shelf-life than their whole counterparts because of enzymatic browning, ripening, texture decay, rapid microbial growth, and undesirable volatile production. How to hold on the freshness in natural way is becoming a great challenge that manufacturers face.

Our natural solutions include **Natasan™**, **Plantéria® CF**, **Proteria®**, **Guardox™ AE** and **Koatilm™** provide natural preservation for shelf-life extension of fruit and vegetables.

Applications

Post-harvest fruits	Fresh-cut fruits	Fruit preparation	Vegetable preparation
			

6.1 Post-harvest fruit and vegetables

Losses due to post-harvest disease may occur at any time during post-harvest handling, from harvest to consumption. Fresh fruits and vegetables remain metabolically and developmentally active to growth, maturation, physiological maturity, ripening, and senescence. Fungal decay and browning are important affecting factors in all fresh fruit and vegetables. For examples, pineapple and banana are one of the most popular tropical fruits in the world and mainly exported worldwide.

6.1.1 Banana

After cutting the banana hand from the main stem, crown rot disease of bananas, caused by *Colletotrichum musae*, *Fusarium* spp. and *Lasiodiplodia theobromae* can cause extensive postharvest losses. **Figure 1** shows that application of Koatilm™ significantly decreased disease severity.

Disease Severity

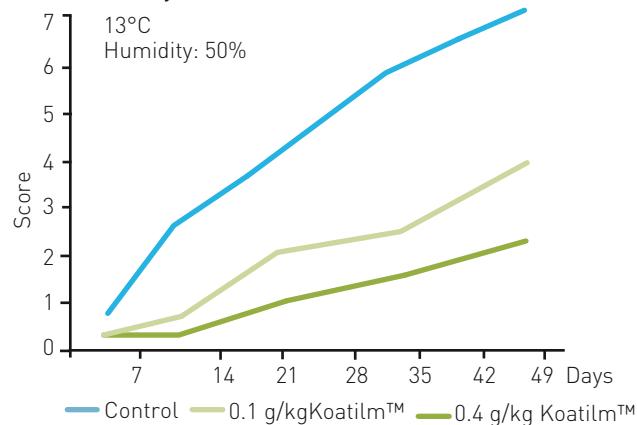


Figure 1 Banana

6.1.2 Pineapple

Black rot, caused by the fungus *Thielaviopsis paradoxa*, is typically the most common and severe post-harvest disease of pineapple. Infestation started at the stalk-end of the pineapple after 8 to 12 hours, after wounding and symptoms begin as a soft, watery rot which later darkens due to growth of the-dark- "rot" a fungal mycelium and spores.

Disease Severity

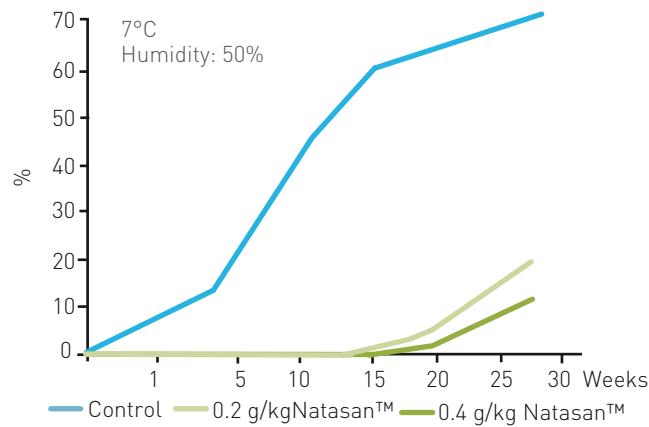


Figure 2 Pineapple

However, fungal diseases destroy more than 30% of the crop yield. Traditionally, synthetic fungicides are used to control fungal diseases, but limited to the regulations of exported countries. Fruit packers have to choose natural alternatives to control fungal diseases.

Our solutions include **Koatilm™** and **Natasan™** are perfect coating to form complete surface treatment of postharvest fruit and vegetables.

Banana dipping test in different solutions of fungicides like Koatilm™, helped maintain a good fruit quality during 25 days of storage in low temperatures and during 8 days at room temperature.

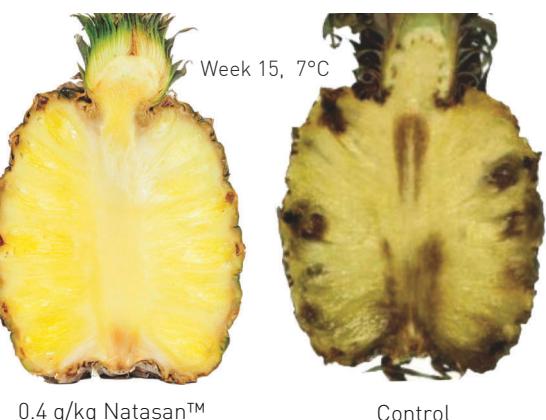
Comparison



Picture 1

Control of black rot is achieved by minimizing mechanical injury to the fruit coupled with appropriate fungicides. **Figure 2** shows that dipping pineapple with 0.4g/kg **Natasan™** for 10 seconds within 5 hours after harvest, stored at 7°C, can minimise the black rotting, which helped maintain a good fruit quality during 15 weeks of storage.

Comparison



Picture 2

6.2 Fresh-cut salads

The increasing demands of fresh-cut salads are due to their fresh-like character, convenience, and human health benefits, but minimally processed products become more perishable.

Our natural solutions include **Plantéria™ CF** and **Antibräun™** can prevent microbial decay and browning in fresh-cut salads.

6.2.1 Fresh-cut apple

Traditional anti-browning agents such as citric acid can cause the bitterness of fresh-cut fruits. **Antibräun™** is natural lemon and citrus juice concentrate containing Bioflavonoids, Polyphenols, ascorbic acid and citric acid, which removes the bitterness-caused substances and

retards the browning and microbial decay for freshness extension of fresh-cut fruits.

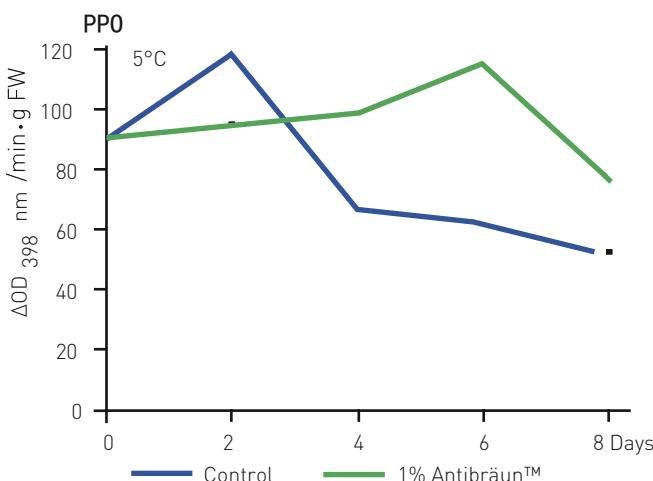


Figure 3 Fresh-cut apple

6.2.2 Fresh salad

Fresh salad was inoculated with *L. monocytogenes* culture, and treated with **Plantéria® CF** at 100 or 200 mg/kg after 30 minutes, the result as **Figure 5** shows that *L. monocytogenes* was below the detection limit of 1 cfu/cm² after 12 days storage at 7°C.

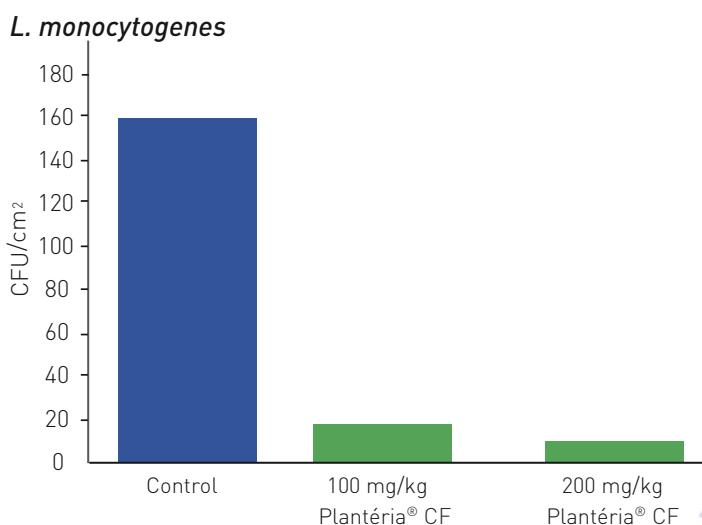


Figure 5 Fresh salad

Decay rate

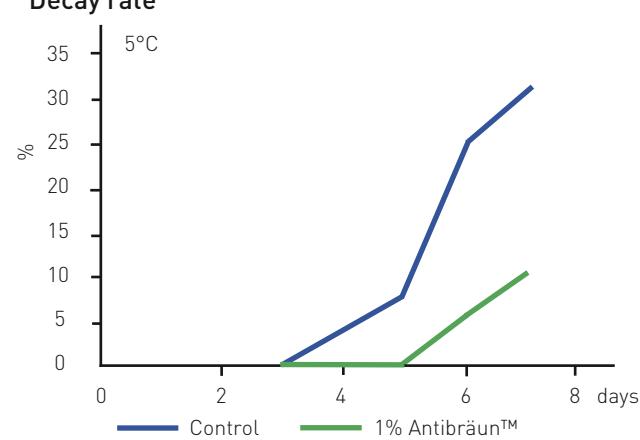
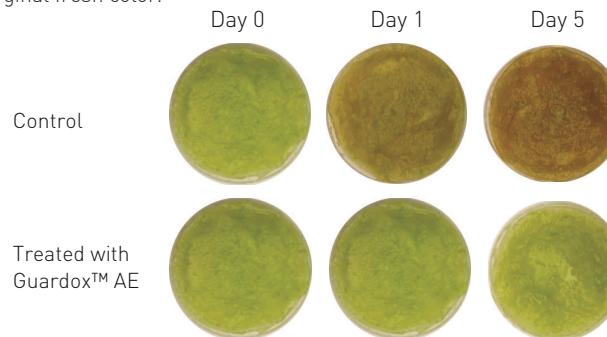


Figure 4 Fresh-cut apple

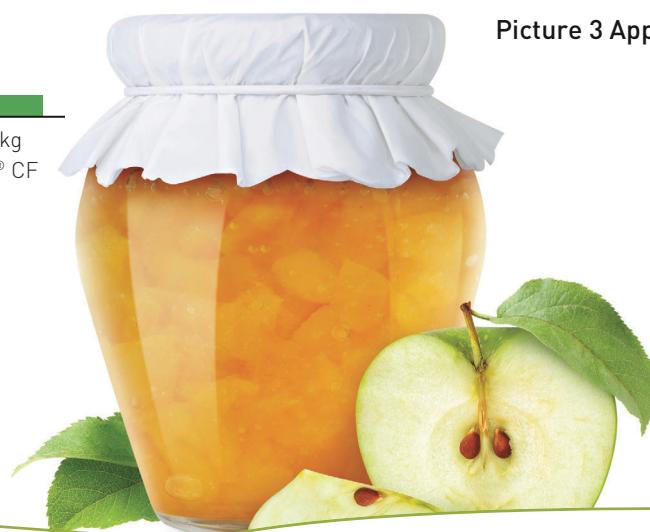
6.3 Fruit preparation

6.3.1 Apple jam

Enzymatic browning occurs naturally in fruits. **Picture 3** indicates that when apple jam was treated with **Guardox™ AE**, it maintained its original fresh color.



Picture 3 Apple jam



6.4 Fermented, acidified and pickled Vegetables

Conventionally, organic acid and sodium chloride (NaCl) are used as the primary preservatives for most types of products of fermented, acidified and pickled vegetables. However, high salt or sugar will be harmful to consumer's health.

6.4.1 Pickled Cucumber

To decrease salt and sugar concentration to 7% with the addition of 0.4% **Proteria® SR** in pickled cucumber, stored at 37 °C. The results can be acceptable after 22 days, when compare to the control group.

6.4.2 Canned mushroom

Bacillus spp. and *Clostridium* spp. are common food spoilage bacteria in canned vegetables. For examples, the addition of **Proteria® CA** was added to low-acid canned mushroom efficient to reduce the heat process time and extend the products' shelf life significantly. and the addition with **Proteria® CA** sterilized at 100 °C for 6-20 minutes still maintained good textures and taste crispy after storage for 2 years.

Our clean-label solutions - **Proteria®** and **Guardox™ AE** can be used alone or together to extend shelf-life significantly.



Table 1. Natural Shelf-life Solutions for Fruits and Vegetables

Applications		Benefits	Brands	Dosage	Labeled as
Post-harvest fruits	Citrus fruits	Anti-ripening, browning and fungal decay	Koatilm™	5-10 g/kg	Natural extracts
		Mold inhibition	Natasan™	0.2 g/kg	Natamycin, Chitosan
	Fig	Anti-ripening, browning and fungal decay	Koatilm®	4-10 mg/kg	Chitosan, Citrus extract
	Melon	Anti-ripening, browning and fungal decay	Natasan™	0.2 g/kg	Natamycin, Chitosan
	Pineapple	TPC inhibition	Natap®	400 mg/kg	Natamycin
			Natasan™	4 g/kg	Natamycin, Chitosan
	Pome fruits (e.g. apple, pears)	Anti-ripening, browning and fungal decay	Koatilm™	3- 10 mg/kg	Natural extracts
		Mold inhibition	Natasan™	2.5 g/kg	Natamycin, Chitosan
	Stone fruits (e.g. cherries, Nectarines)	Anti-ripening, browning and fungal decay	Koatilm™	5-10 mg/kg	Chitosan, Citrus extract
		Mold inhibition	Natasan™	1.5 g/kg	Natamycin, Chitosan
	Strawberry	Anti-ripening, browning and fungal decay	Koatilm™	5-10 mg/kg	Natural extracts
	Tropical fruits (e.g. Avocados, Mangoes)	Anti-ripening, browning and fungal decay	Koatilm™	10-20 mg/kg	Natural extracts
		Mold inhibition	Natasan™	0.8 g/kg	Natamycin, Chitosan
Fresh-cut fruits	Fresh salad (e.g. apples, cattail, grape, lettuce, mango, melon, pineapples)	Anti-browning	Antibräun™	0.8-1 g/kg	Citrus-lemon extracts
		Anti-TPC	Plantéria™ CF	1 g/kg	Citrus extract
Fruit preparation	Prepared fruit and fruit mixtures	TPC inhibition	Epolyl®	250 mg/kg	ε-Polylysine
	Fruit fillings for pastries		Epolyl® HCL	250 mg/kg	ε-Poly-L-lysine HCL
	Frozen fruit bars and sorbet	TPC inhibition	Plantéria® CF	1g/kg	Citrus extract
		TPC inhibition	Epolyl®	250 mg/kg	ε-Polylysine
Post-harvest vegetables	Mushroom	Growth control of yeasts & molds	Epolyl® HCL	250 mg/kg	ε-Poly-L-lysine HCL
			Natasan™	1.5 g/kg	Natamycin, Chitosan
Fresh-cut vegetables	Fresh-cut bamboo shoots	TPC inhibition	Antibräun™	1 g/kg	Citrus-lemon extracts
Vegetable preparation	Potato- and sweet potato-based foods	TPC inhibition	Epolyl®	250 mg/kg	ε-Polylysine
	Vegetable-based prepared foods		Epolyl® HCL	250 mg/kg	ε-Poly-L-lysine HCL
	Acidified pickles, olives	TPC inhibition	Epolyl®	100-250 mg/kg	ε-Polylysine
	Dry beans and bean-based prepared foods		Epolyl® HCL	250 mg/kg	ε-Poly-L-lysine HCL
		Growth control of fungi and Gram+/- bacteria	Epolyl®	250 mg/kg	ε-Polylysine
			Epolyl® HCL	250 mg/kg	ε-Poly-L-lysine HCL