PANAFERD

Naturally derived Astaxanthin & carotenoids
from *Paracoccus carotinifaciens*

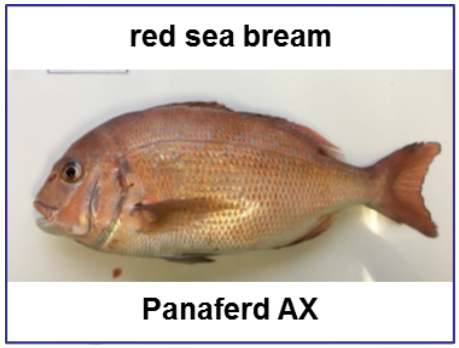
Natural colorant & Health feed

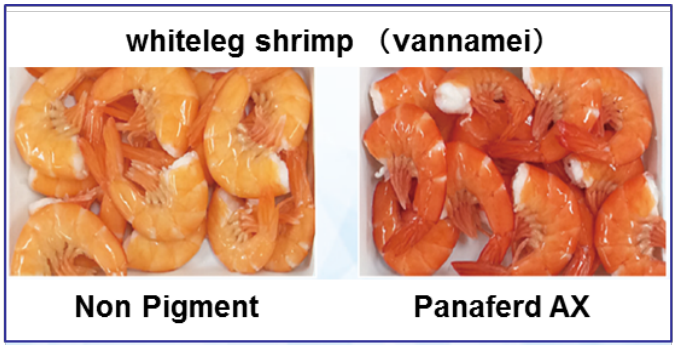
JX Nippon ANCI Corporation

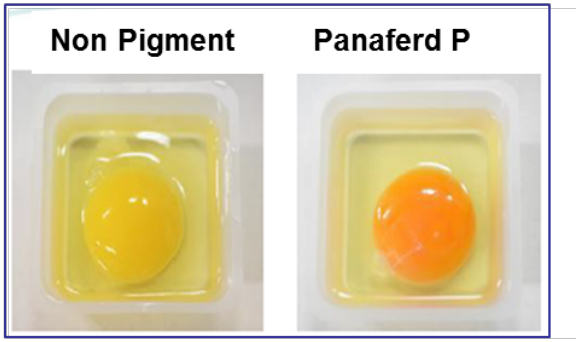
What is PANAFERD?

Panaferd comes from the microorganism *Paracoccus carotinifaciens*. This microorganism is one of many components in the start of the food chain in the aquatic environment and produces eight carotenoids, including astaxanthin.

Panaferd is the most efficient and natural way to supply farmed fish, shrimp and chicken egg the carotenoids they need for their health and color.



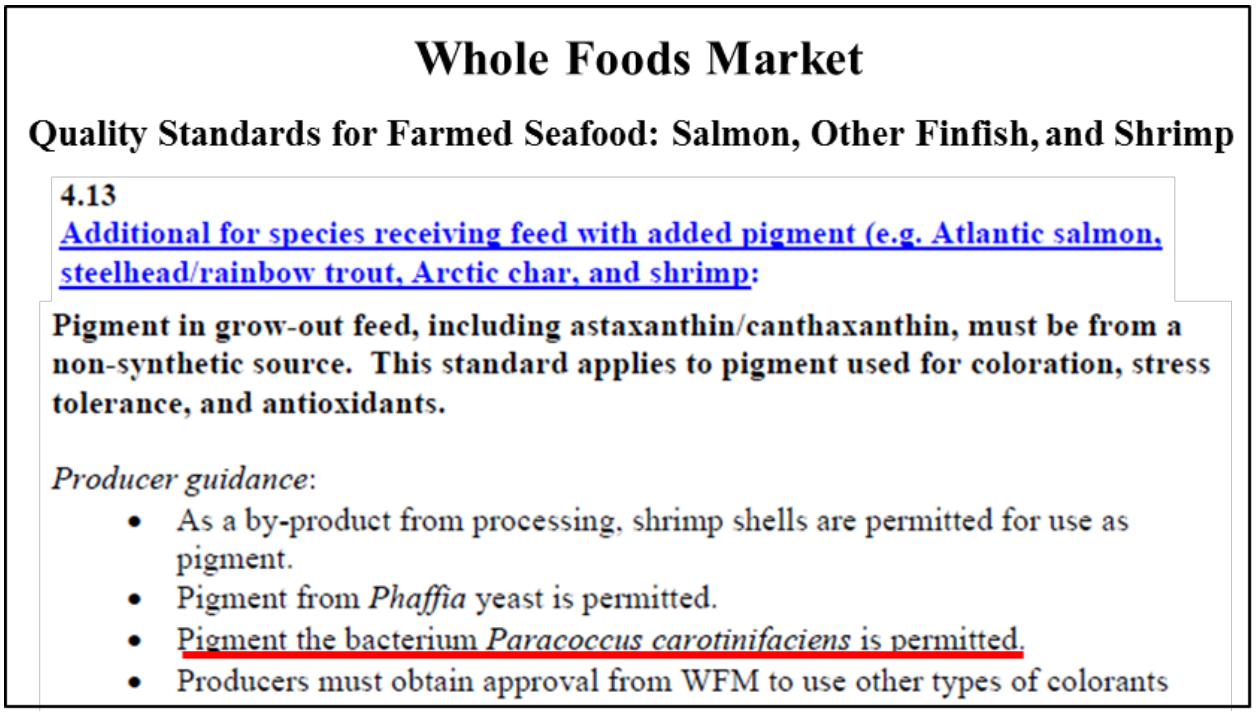




Why is PANAFERD?

Consumer Awareness

Consumer expectations for more natural food that is free of synthetic additives are now more prevalent around the world. The development of organic aquaculture clearly answers to this market request. Major food stores around the world have developed their own food quality standards, including sustainability and food safety as major issues. In the U.S., Whole Foods Market® product labels state that their seafood does not include synthetic pigments.



Whole Foods Market

Quality Standards for Farmed Seafood: Salmon, Other Finfish, and Shrimp

4.13
Additional for species receiving feed with added pigment (e.g. Atlantic salmon, steelhead/rainbow trout, Arctic char, and shrimp:

Pigment in grow-out feed, including astaxanthin/canthaxanthin, must be from a non-synthetic source. This standard applies to pigment used for coloration, stress tolerance, and antioxidants.

Producer guidance:

- As a by-product from processing, shrimp shells are permitted for use as pigment.
- Pigment from *Phaffia* yeast is permitted.
- Pigment the bacterium *Paracoccus carotinifaciens* is permitted.
- Producers must obtain approval from WFM to use other types of colorants

Why is PANAFERD?

Consumer Awareness

Walmart Offers New Vision for the Company's Role in Society

Philadelphia, Pa. – November 4, 2016 –

・Sell more sustainably produced products while maintaining the low prices customers expect:

◦Affordable, safe and healthier: Walmart will double the sales of locally grown produce in the U.S. by 2025 and work with suppliers and its own private brand products to remove certified synthetic colors and artificial flavors in products where customers don't expect to find them, as well as reduce sodium, added sugars and saturated fat where possible. Additionally, Walmart will expand and enhance sustainable sourcing to cover 20 key commodities, including

Why is PANAFERD?

Consumer Awareness

In Europe, all the premium Scottish salmon farmers claim the use of natural pigment as part of their quality standards.

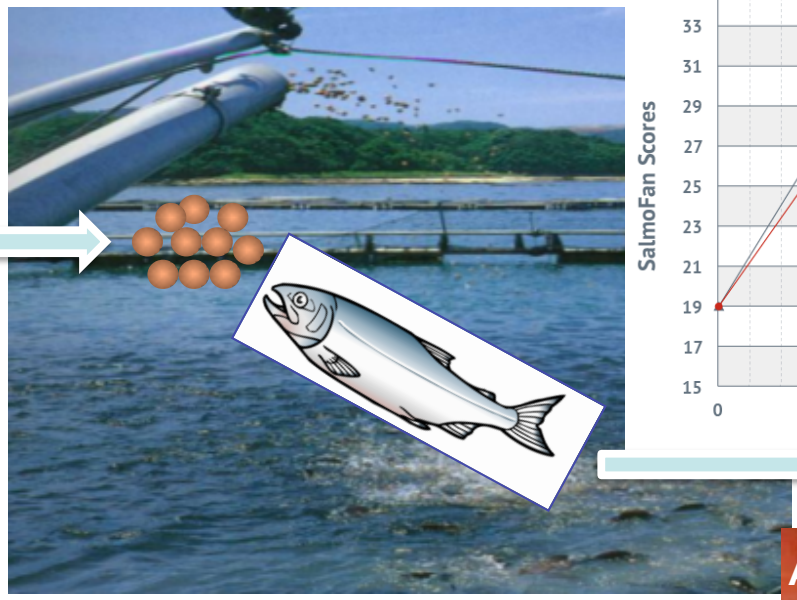
Physical Features of PANAFERD®-AX

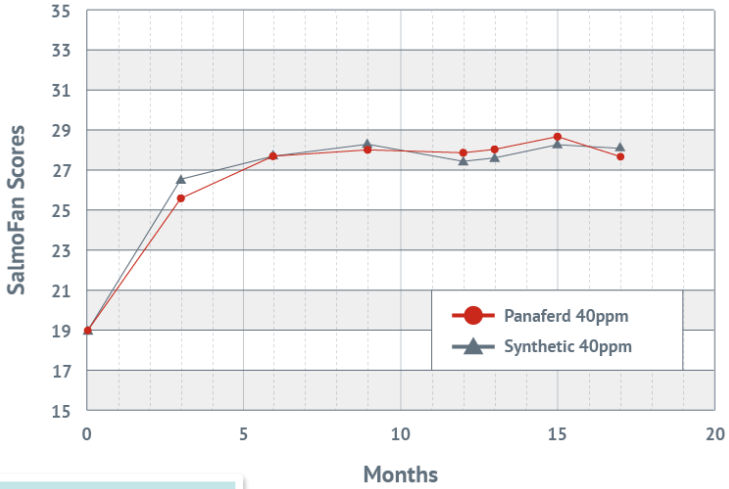
TEST	ANALYSIS SAMPLE	SPECIFICATIONS
Astaxanthin	22 g/kg	20-23 g/kg
Adonirubin	7 g/kg	7-15 g/kg
Canthaxanthin	2 g/kg	1-5 g/kg
Total carotenoids	36 g/kg	-
Loss on Drying	2 %	≦ 7 %

ITEM	CONTENT		
Appearance	Dark Red Powder		
General Analysis	Composition Sample	Crude Protein	45.3 %
		Crude Fat	7.9 %
		Crude Fiber	< 0.1 %
		Crude Ash	7.2 %
		Moisture	2.3 %
		Nitrogen Free Extract	35.2 %
Packaging	Aluminum Bag 500 kg or 10 kg x 2 units in one		

Application to Salmon

PANAFERD®-AX





marineharvest

SALMAR

THE SCOTTISH SALMON COMPANY

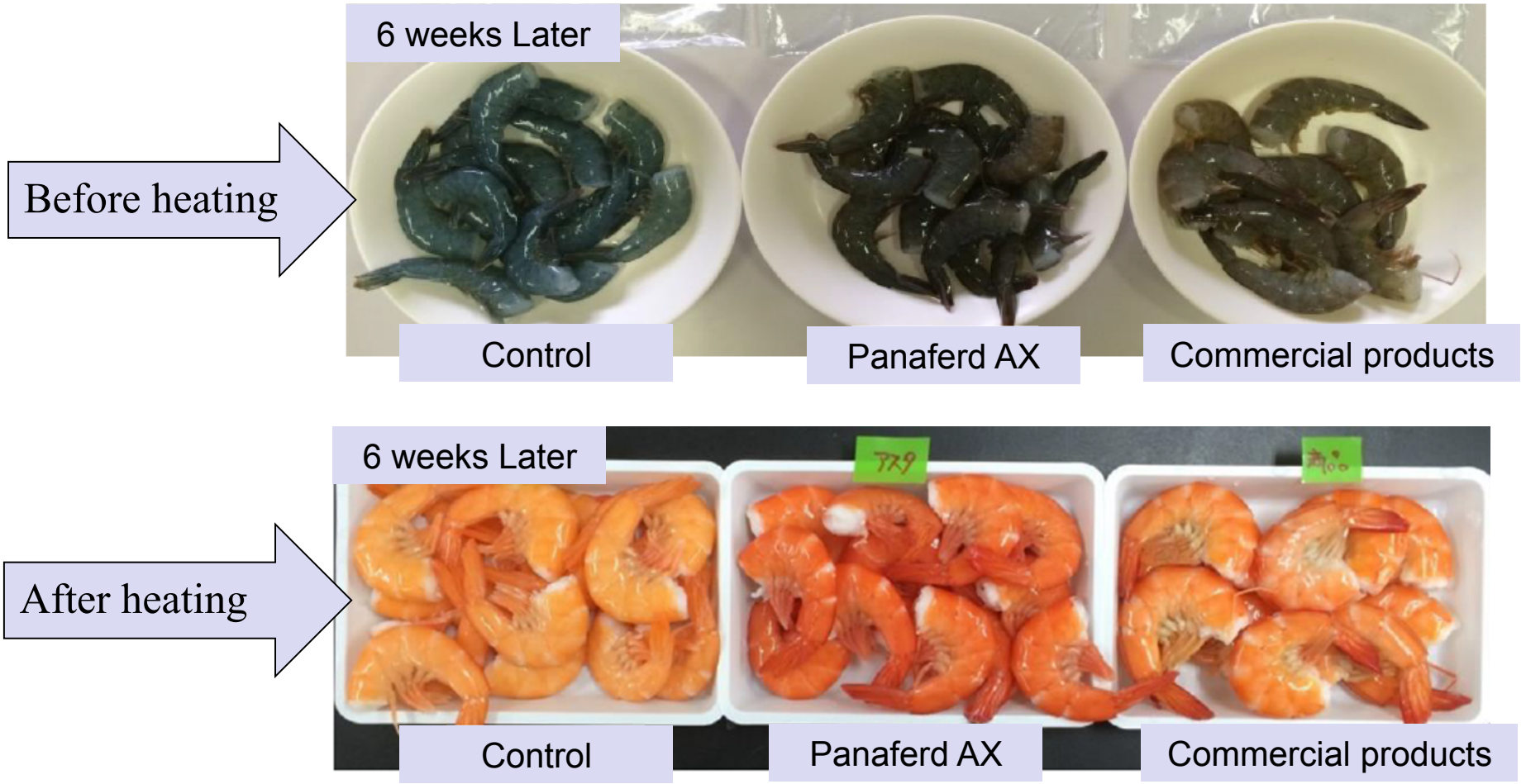
GLENARM ORGANIC SALMON

Annual sale volume: >1,300 ton
Pigment share for salmon: 15%

Application to Shrimp

Efficacy Study of Vannamei

Coloration (Redying) : Comparison of control, Panaferd AX and Commercial products

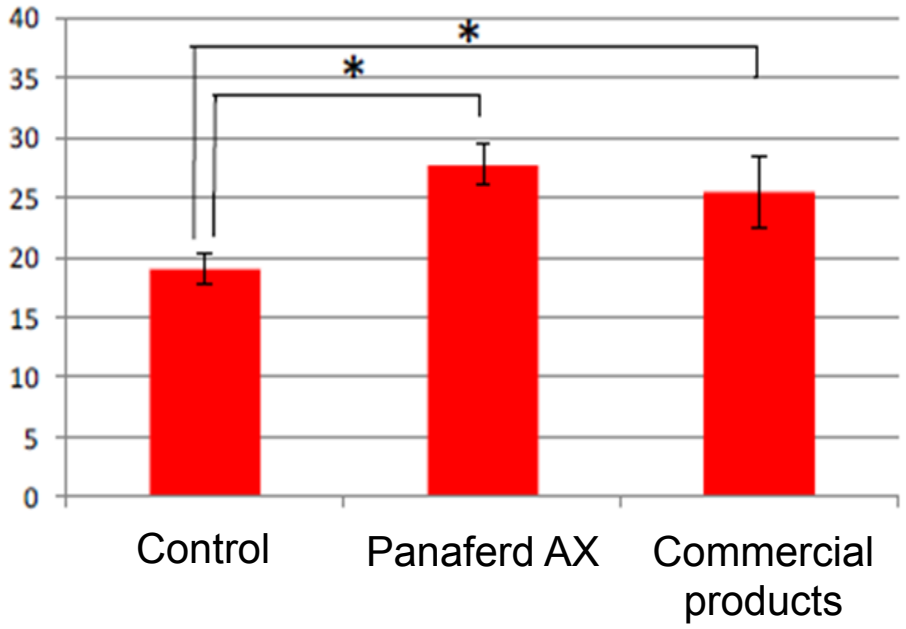


Application to Shrimp

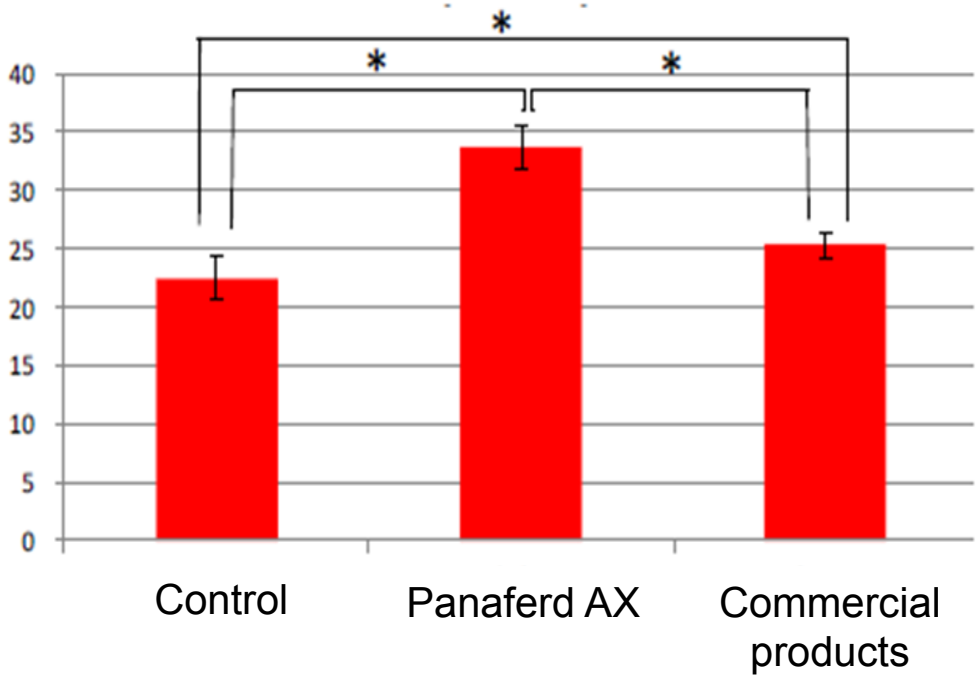
Efficacy Study of Vannamei

Measurement of redness : color-difference meter (a* value)

3 weeks Later



6 weeks Later

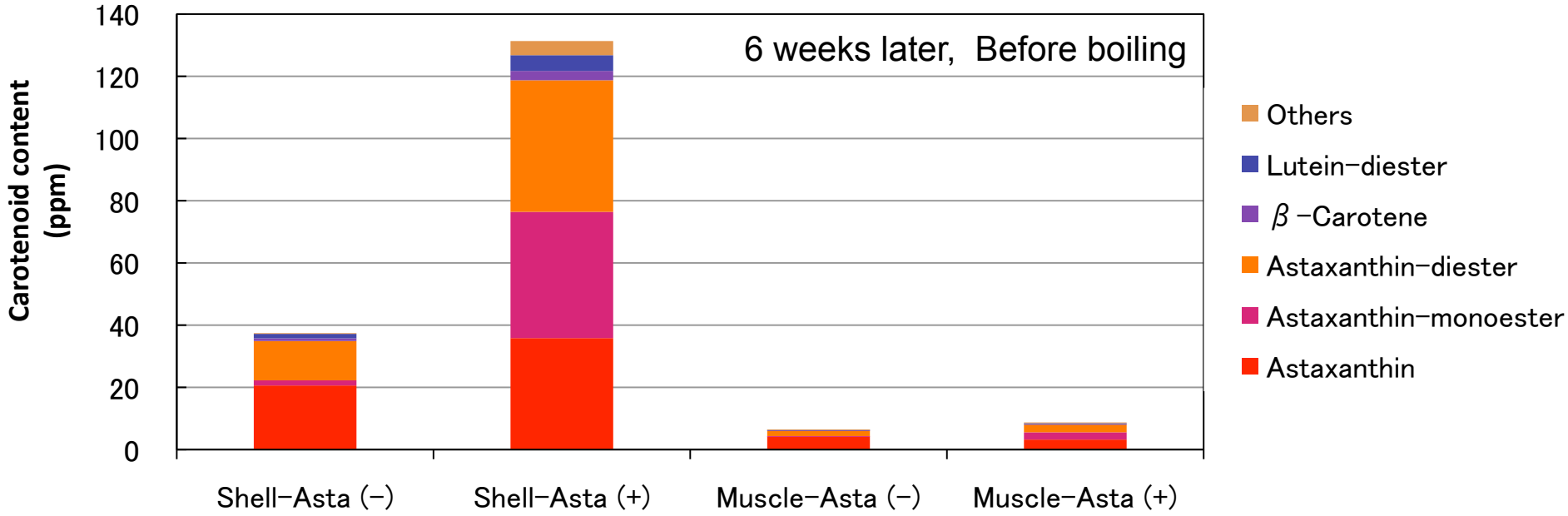


* Significant difference, $p < 0.01$

Application to Shrimp

Efficacy Study of Vannamei

Measurement of carotenoid content : HPLC



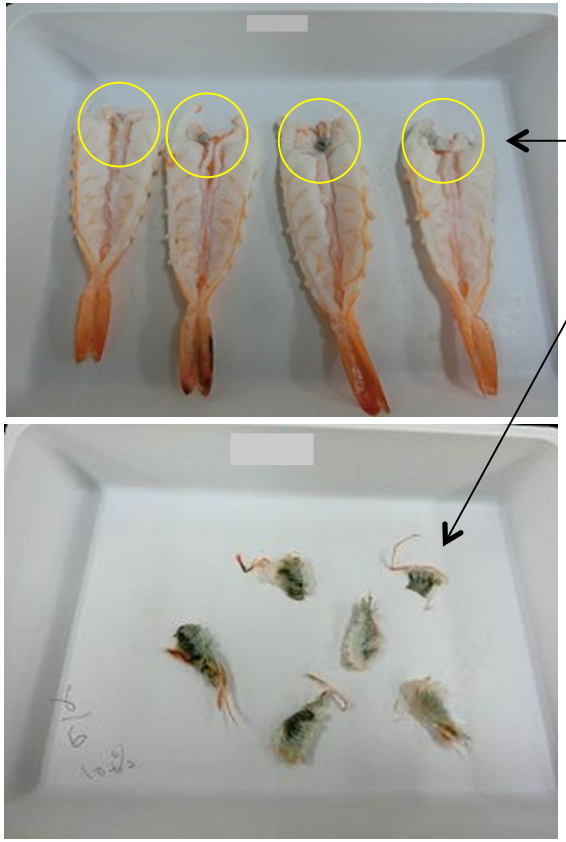
Shell-Asta (-)	no added PANAFERD
Shell-Asta (+)	2,500 ppm PANAFERD (50 ppm Astaxanthin)
Muscle-Asta (-)	no added PANAFERD
Muscle-Asta (+)	2,500 ppm PANAFERD (50 ppm Astaxanthin)

Application to Shrimp

Efficacy Study of Vannamei

Improvement of commercial value : Prevention of blackening*

* change color to black near a gill by melamine



Blackening

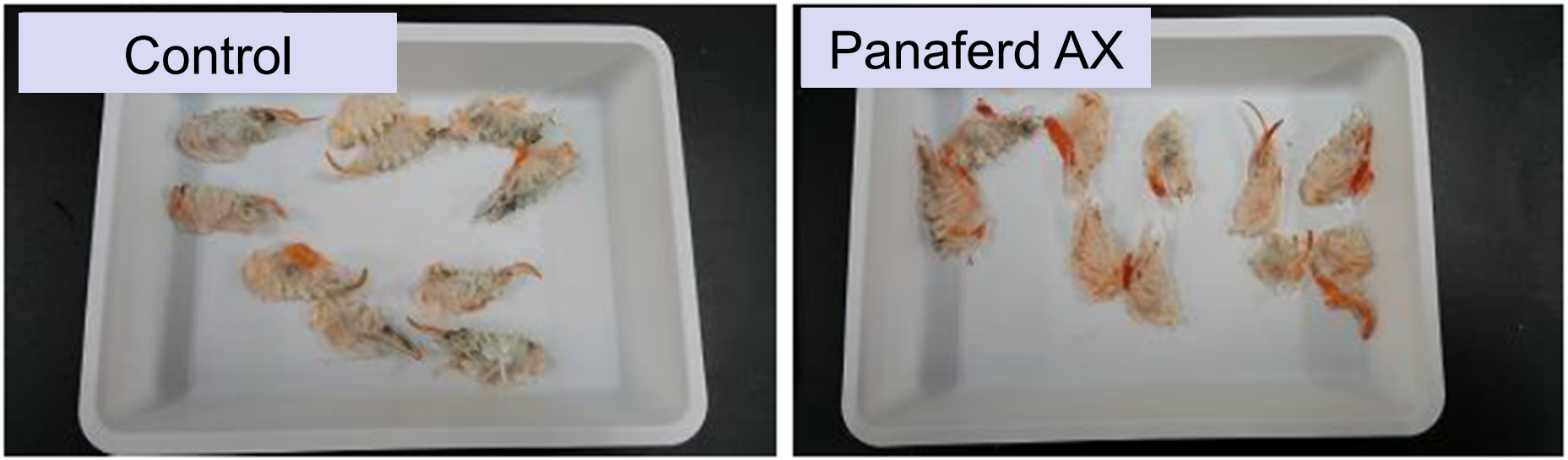
get complaints

Application to Shrimp

Efficacy Study of Vannamei

Improvement of commercial value : Prevention of blackening*

＊ change color to black near a gill by melamine



Occurrences of blackening	Control	Panaferd AX
3 weeks later	6／6 shrimps（100%）	6／10 shrimps（60%）
6 weeks later	9／10 shrimps（90%）	6／10 shrimps（60%）

Reference : Authorization as Feed Additive

Safety studies

Mutagenicity （4types）
Acute toxicity
Subcronic toxixity
- 90 days study with rats and rainbow trout

Worker safety
Environmental assessment

Stability studies

In product
In feed
In fish flesh

Efficacy studies

【Lab scale studies】
Rainbow trout （Japan）
Coho salmon （Japan）
Atlantic salmon （Scotland）
【Field studies】
Rainbow trout （Chile）
Atlantic salmon （Scotland）
Coho salmon （Japan）

Authorized in
Europe （August, 2008）
US (FDA) （December, 2009）
Canada （April, 2014）

Application to Chicken egg

1. Consumer → Easy health promotion

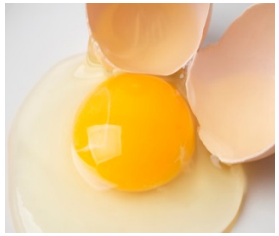
✔ Astaxanthin has the following efficacy published in academic papers.

①Beautiful skin ②improved visual function
③brain and neurological disease prevention ④ lifestyle-related disease prevention
⑤improved motor function

✔ Egg yolk carotenoids are taken into the body more efficiently than supplements.

2. Your company → Formation of Royal customer

✔ Reddish egg yolk color remains in memory when breaking up eggs.



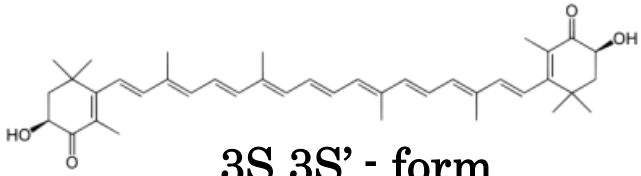
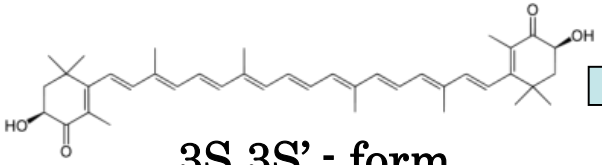
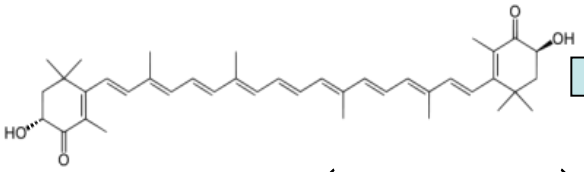
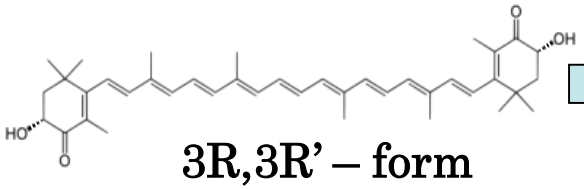
Use of Panaferd P

✔ Reddish egg yolk color remains after cooking.

Use of Panaferd P

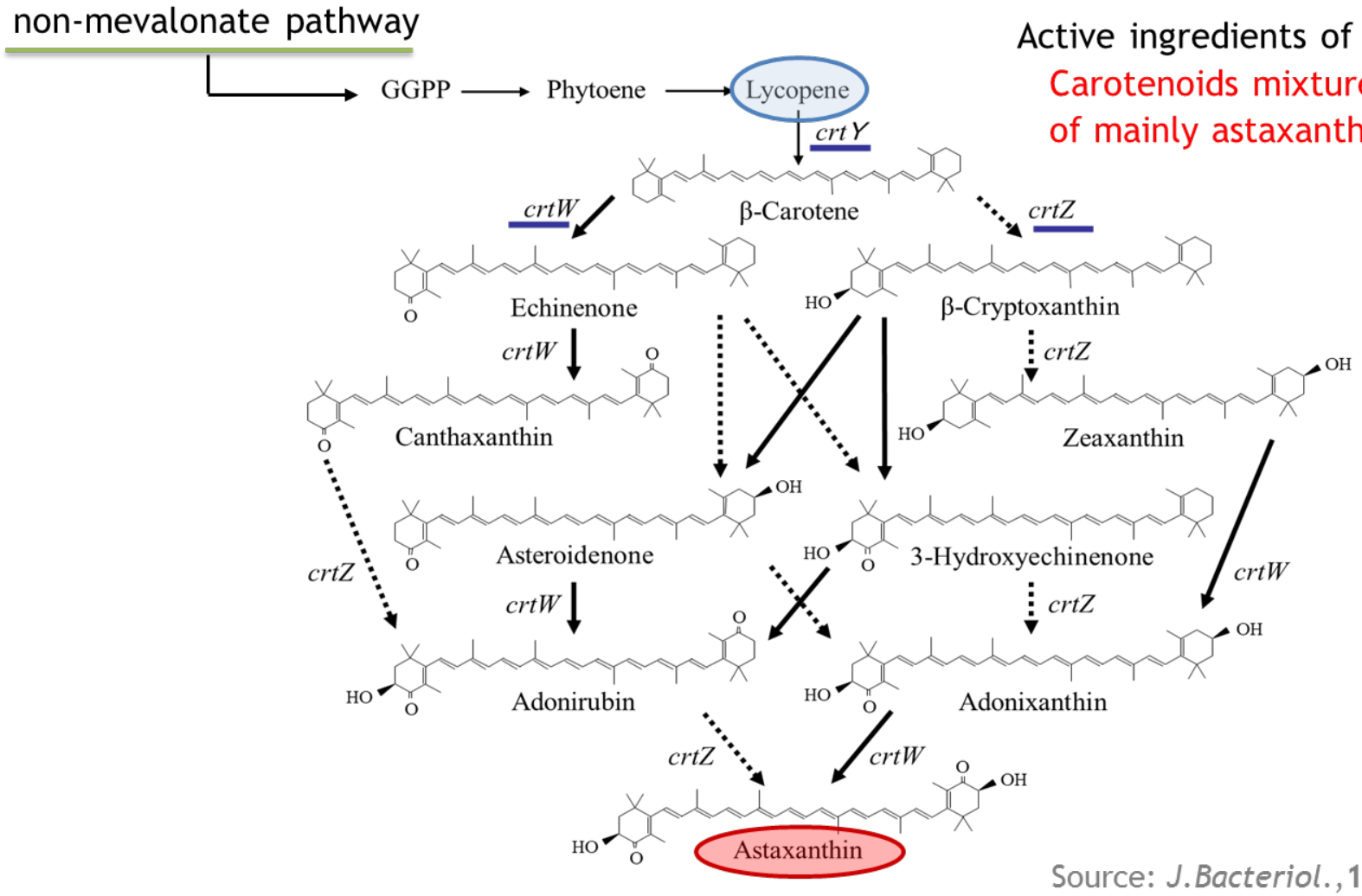
Egg nutrition
+
Efficacy
+
Pleasure

Reference : Comparison of Astaxanthin

Origin	Optical isomer	
P. carotinifaciens (PANAFERD®-AX)	 3S,3S' - form	・Low material of Health Food ・NDI, Notification GRAS
Synthetically Astaxanthin	1  3S,3S' - form : 2  3S,3R'-form (meso-form) : 1  3R,3R' – form	**Natural material** *Haematococcus pluvialis* **Non Natural material** NDI, Notification GRAS **Natural material** Phaffia yeasts

Astaxanthin and its metabolic intermediates

Carotenoid biosynthesis pathway of genus *Paracoccus*



Active ingredients of *Paracoccus*:
Carotenoids mixture composed of mainly astaxanthin

Source: *J.Bacteriol.*, **177**, 6575 (1995)

Reference: Astaxanthin

Astaxanthin is a health food material that is garnering attention as a necessary ingredient for maintaining youth and continuing a healthy lifestyle. Antioxidant effect of Astaxanthin is 1000 times more than that of vitamin E.

1. Efficacy

Astaxanthin effects include scavenging of reactive oxygen that damages cells,[1)] and inhibition of lipid oxidation in the cell membrane,[2)] then it is useful in maintaining vital activity.

Beautiful skin,[3)] improved visual function,[4)] brain and neurological disease prevention,[5)] lifestyle-related disease prevention,[6)] and improved motor function,[7)] etc., have been reported as effects of astaxanthin.

Astaxanthin that has captured reactive oxygen releases the reactive oxygen energy as heat, so it does not change into a pro-oxidant.[8)] It can be used as a safe antioxidant.

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2) Miki W, *Pure & Appl. Chem*., **63**, 141-146 (1989).
3) Seki T, *et al., Fragrance J*., **29**, 98-103 (2001). Yamashita E., *Fragrance J*., **34**(3), 21-27 (2006). Arakanese K., *Carotenoid Science*, **5**, 21 (2002).
4) Nitta T, *et al., J Cli. Thera & Med*, **21**(25), 543-556 (2005). Takahashi N., *et aj., J Cli. Thera & Med*., **21**(4), 431-436 (2005). Setani Y. *et al., J Physi. Anthro*, **14**(2), 59-66 (2009).
5) Schmidt-Hieber C, *et al*., *Nature*., **429**(6988), 184-187 (2004). Frautschy SA, *et al*., *Neurobiol Aging*., **22**(6), 993-1005 (2001). Satoh A, *et al*., *J. Clin. Biochem. Nutr*, **44**(3), 280 (2009).
6) Nishida Y, *et al*., *Biogerontology*, **10**, 443 (2009). Hussein G, *et al*., *Life Science*, **80**, 552 (2007). Ikeuchi K, *et al*., *Biosci Biotechnol Biochem*., **71**, 893-899 (2007)
7) Malmsten C. L., *Carot. Science*, **13**, 20 (2008). Earnest C. P., *et al*., *Int. J. Sports Med*., **32**, 882 (2011).
8) Martin H. D., *et al*., *Pure Appl Chem*., **71**, 2253 (1999).