

TO **Food Standards Australia New Zealand (FSANZ)**

DATE January 9, 2014
SUBJECT Call for submissions on criteria for *Listeria*
Monocytogenes in ready-to-eat foods
REFERENCE 2014 01 09 Corbion Purac FSANZ Submission LM in
RTE Foods

First of all thanks for the opportunity to give input for the review of limits for *Listeria*
Monocytogenes in the Food Standards Code.

Corbion Purac is a global leader in food preservation and has successfully developed a portfolio of ingredients based preservation solutions for a wide range of food products. This portfolio of solutions includes a range of preservation solutions which are specifically targeted at *Listeria Monocytogenes*. We are a global company with manufacturing capabilities on 4 continents and sales and customer support presence in many countries a.o. in Australia and New Zealand.

We believe the regulations are clear and well written though a little more guidance on bactericidal interventions concerning *Listeria Monocytogenes* would be helpful. Especially reference is made to "Supporting document 1".

We kindly ask to consider the integration of the following items in this "Supporting document 1".:

1. On page 8: Key process parameters

We suggest reference is made to a list of known interventions alike salts of organic acids (sorbates, benzoates, lactates, acetates, di-acetates, propionates, etc.). We would be able and very much willing to support you in providing evidence for the effectiveness of these products against *Listeria Monocytogenes*. Enclosed to this memo we have included information that support this statement especially concerning the effectiveness of lactates and acetates.

2. On Page 9: Predictive microbiological models

We believe that the Listeria Control Model as developed by Corbion is worthwhile to be included in the list of models which the FSANZ refers to in "Supporting document 1" for the following reasons:

- a. The Listeria Control Model exists for already 12 years and has proven to be a valuable tool for many food processors producing a wide variety of products
- b. The Listeria Control Model is throughout the 10 years of existence loaded with data from not only our own studies but also with data from studies from food processors. Consequently it has developed into a collective knowledge tool. Besides have the many data added improved the model as such.
- c. The Listeria Control Model does not only model Listeria Monocytogenes but many more micro-organisms
- d. The model can be used for a variety of food products i.e.:
 - i. Processed foods
 - ii. Cooked meat & poultry
 - iii. Refrigerated food
 - iv. Soft cheeses
 - v. Salads and dressings

The Corbion Listeria Control Model is available on-line: www.corbion.com/lcm

Enclosed to this letter is an information sheet titled "Predictive growth modeling in food" which briefly explains the model and how it can be used by food processors and others.

Last but not least I want to emphasize that we are able to support the above request with a large amount of information. The enclosed documents are just a few examples of what we have available.

Let me know in case you would like to receive additional information or in case you have any questions.

Kind regards,

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Predictive growth modeling in food



- ▶ Reduced R&D cost
- ▶ Speed up time-to-market
- ▶ *Listeria* growth prediction
- ▶ Microbial expertise

Food producers are challenged to develop quality products with good shelf life in a relative short amount of time. Many processors experience associated safety testing as a lengthy and costly process. To alleviate product development of safety studies, predictive growth modeling has proven itself as valuable support.

A reliable growth model is able to project microbial growth in specific food formulations, enabling processors to reduce valuable R&D time, speed up time-to-market and increase the efficiency of new product development.

Growth models use mathematics to describe growth or death effects on microorganisms caused by its environmental conditions. The reliability of a model depends on the amount of environmental characteristics taken into account. In food products, some of the most important characteristics are storage temperature, salt level, moisture content, pH, water activity and antimicrobials.

Developing such models requires extensive data sets obtained from specifically designed challenge studies. Validation experiments are used to verify the situations in which a model is useful. The modeling approach described above is very general: it can be applied to the outgrowth of pathogens such as *Listeria* and to the growth behavior of food spoilers. The methods are general and applicable to a multitude of microorganisms and food matrices.

Predictive growth modeling in food

Microbial growth depends on its environment

Microbial growth can be divided into three stages and plotted into a curve as depicted in figure 1. After a period in which microbes prepare for outgrowth (lag time), the cell concentration increases exponentially with an almost constant rate. In the final stage, this rate levels off and growth stops completely.

The parameters λ (lag time), μ (growth rate) and A (maximum cell count) can be used to describe such curve. Food product characteristics like water activity, pH, and antimicrobials strongly influence the values of λ and μ .

The Gamma¹ concept in microbial modeling

Growth models are based on the so-called building block principle, described as the hurdle concept, where each environmental factor is seen as a hurdle to microbial growth. Increasing a hurdle (e.g. cooling a product) will result in a longer lag time and lower growth rate. Both help to extend the shelf life of the product or increase the safety margin.

In modeling each hurdle is quantified as a number, the gamma factor (γ). A low gamma factor indicates a strong growth hurdle and thus a higher reduction of microbial growth. Table 1 shows an illustrative set of γ -values related to specific food characteristics. Multiplication of these values results in a single value 'γ overall', which is used to determine microbial growth. A change in the 'γ overall' is directly related to the change in growth.

Listeria Control Model 2012

Corbion Purac offers a unique tool – The *Listeria* Control Model. The *Listeria* Control Model 2012 is an easy to use, online edition on the forefront of growth modeling. It is adjustable for eight food characteristics and applicable for a wide variety of food items such as cooked meat, RTE meals, soft cheeses and salads.

- ▶ Accurately predict *Listeria* growth
- ▶ Save valuable R&D cost
- ▶ Speed up time-to-market

Go to www.corbion.com/lcm to find out more.

Schematic view of microbial growth over time for two different product formulations.

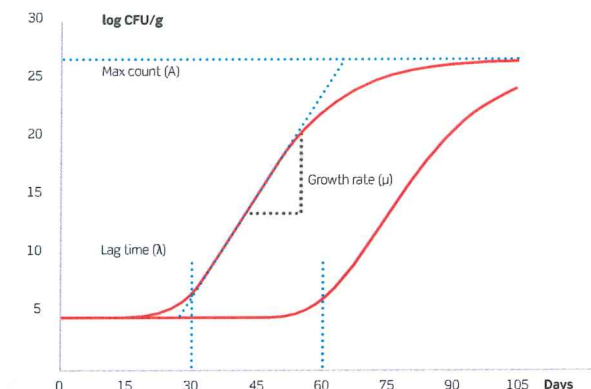


Figure 1

Schematic view of the Gamma concept. γ -values* are multiplied to obtain a single value: 'γ overall'. This example is applied to the lag time shown in figure 1.

	Control		With Purac product	
pH	6.2	$\gamma = 0.8$	6.2	$\gamma = 0.8$
Temperature	4°C/39°F	$\gamma = 0.5$	4°C/39°F	$\gamma = 0.5$
NaCl	2%	$\gamma = 0.6$	2%	$\gamma = 0.6$
Purac product	-	$\gamma = 1.0$	1.5%	$\gamma = 0.5$
γ overall	0.24		0.12	
Corresponding lag time (λ)	30 days		60 days	

* The values used in this example are fictional.

Interested in our solutions? Go to corbion.com/lcm

 @CorbionFood

With over 80 years of fermentation expertise and the use of natural raw materials to produce exceptional food and beverage ingredients, Corbion Purac has a wealth of expertise in the world of bio-based food ingredients. Corbion is the global market leader in lactic acid, lactic acid derivatives and lactides, and a leading company in functional blends containing enzymes, emulsifiers, minerals and vitamins. Corbion operates 10 production plants, in the USA, the Netherlands, Spain, Brazil and Thailand, and markets its products through a worldwide network of sales offices and distributors.

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Opti.Form® Powder Ace S61

A low cost *Listeria* control solution



Opti.Form® Powder Ace S61



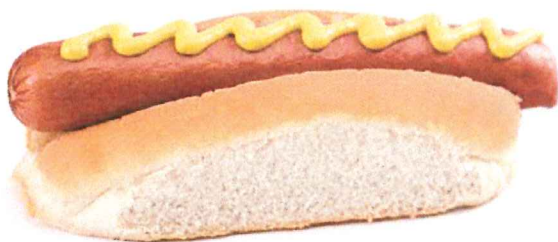
Cost-effective



Listeria control



Powder blend
for ease of use



About Opti.Form Powder Ace S61

Opti.Form Powder Ace S61 belongs to Purac's Opti.Form line of products which are the gold standard in *Listeria* control. Opti.Form Ace Powder S61 is a powder blend of sodium lactate, sodium acetate and sodium diacetate. With its highly effective combination of antimicrobials you are able to save cost up to $\pm 50\%$, while having the advantages of a powder formulation.

Cost effective

Opti.Form Powder Ace S61 is specifically developed to decrease the cost of safety within a product formulation. Reduction of cost up to $\pm 50\%$ is possible, by use of high levels of acetate and diacetate. The powder form allows for a reduction of addition level up to $\pm 80\%$.

Listeria control

The highly effective combination of lactate, acetate and diacetate is a proven inhibitor for *Listeria* growth. Opti.Form Powder Ace S61 can be used till addition level of 0.65%. Above that, the level of sodium diacetate will exceed the regulatory use level of 0.25%. This level enables you to obtain achieve shelf life up to 100 days in most product formulations.

Powder blend for ease of use

Powder products are less expensive to transport and store and often have other advantages in production. Opti.Form Powder Ace S 61 can be combined with seasoning blends allowing for unitized packs.

Targeted use

Opti.Form Powder Ace S 61 is recommended for use in cured and uncured RTE meat items in which a powdered product will provide a benefit. Addition level is lower than liquid equivalents, ranging from 0.4-0.65%.

How much is needed to acquire similar safety levels?

Use level Opti.Form PD4	Use level Opti.Form Powder Ace S61	Reduction addition level up to	Cost in use reduction
2.5%	0.40%	85%	$\pm 50\%$
3%	0.50%	80%	$\pm 50\%$
3.5%	0.65%	80%	$\pm 50\%$

Safety
Shelf Life | Nutrition
Taste

purac.com/costeffective

Not intended for use outside the United States

Opti.Form® Powder Ace S61

A low cost *Listeria* control solution

Purac *Listeria* Control Model 2012

Purac offers a unique tool – The Purac *Listeria* Control Model 2012. This online model is easy to use and is at the forefront of predictive growth modeling. It is adjustable for eight food characteristics and allows you to predict the effect of Opti.Form Powder Ace S61 in your meat products.

The predicted growth is based on specifically designed and validated *Listeria* challenge studies. Predictions are depicted by the model in two ways.

- The 95% line; 95% of all growth is expected to be more slowly than this line.
- The new “best fit” line; the most probable outcome for growth.

Go to www.purac.com/lcm to find out more.

Listeria suppression in chicken frankfurter stored at 4°C/39°F

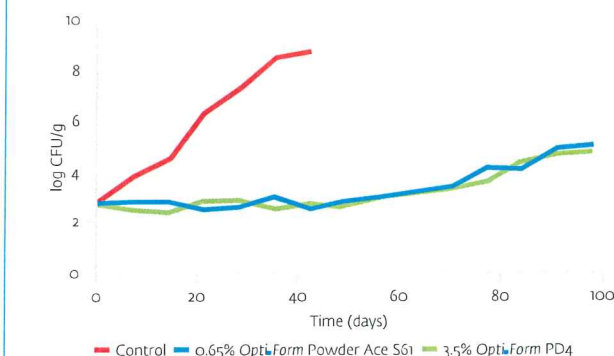


Figure 1

Figure 1 shows the results of a *Listeria* validation testing in a chicken frankfurter, stored at 4°C/39°F. Addition of Opti.Form Powder Ace S61 resulted in the prevention of 1 log outgrowth during 70 days of storage.

Opti.Form® Powder Ace S61

Form	Powder
Labeling	Sodium lactate (38%) Sodium acetate (38%) Sodium diacetate (23%)
Target use level	0.4–0.65%
Sodium impact on product	medium

Parameters chicken frankfurter (Figure 1)

Moisture level	62%
Salt	2%
pH	6.2
a_w	0.971
Opti.Form Powder Ace S61	0.65%



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Purac is a leading company in natural food preservation, lactic acid based bioplastics, biobased chemicals and the worldwide market leader in lactic acid, lactic acid derivatives and lactides. Purac has over 80 years experience in the development, manufacturing and marketing of these products in a broad range of industries. Purac operates production plants in the USA, The Netherlands, Spain, Brazil and Thailand and markets its products through a worldwide network of sales offices and distributors. Purac is headquartered in The Netherlands and is part of CSM.

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Opti.Form® Ace P40

A low cost *Listeria* control solution



Opti.Form® Ace P40



Cost-effective



Avoid regulatory use limits



Listeria control

About Opti.Form Ace P40

Opti.Form Ace P40 belongs to Purac's Opti.Form line of products which are the gold standard in *Listeria* control. Opti.Form Ace P40 is a liquid blend of potassium acetate and potassium lactate, avoiding all sodium contribution to your finished product. Opti.Form Ace P40 enables you to increase your existing levels of safety or reducing cost of safety ingredients up to $\pm 50\%$.

Cost-effective

Opti.Form Ace P40 was specifically developed to decrease the cost of inhibitor use while maximizing safety levels within a product formulation. The high level of potassium acetate in combination with potassium lactate allows for reduced levels, increasing cost-effectiveness up to $\pm 50\%$.

Avoid regulatory use limits

Potassium acetate has a regulatory use limit of 1.2% in a finished meat product, compared with 0.25% for sodium diacetate or sodium acetate. This allows for up to 3% Opti.Form Ace P40 to be used in a finished product.

Listeria control

The combination of lactate and acetate is a proven inhibitor for *Listeria* growth. Opti.Form Ace P40 can be used at high levels to achieve a shelf life of over 120 days and dealing with products which easily support the growth of *Listeria*.

Targeted use

Opti.Form Ace P40 is recommended for use in a variety of cured and uncured RTE meat products. Due to its mild flavor and ability to be used at higher levels it should be your product of choice for uncured items and those in which extra protection is needed.

How much is needed to acquire similar safety levels?

Use level Opti.Form PD4	Use level Opti.Form Ace P40	Reduction addition level up to	Cost in use reduction
2.5%	1.2%	50%	$\pm 50\%$
3%	1.4%	55%	$\pm 50\%$
3.5%	1.6%	55%	$\pm 50\%$

Safety
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Taste

purac.com/costeffective

Not intended for use outside the United States



Opti.Form® Ace P40

A low cost *Listeria* control solution

Purac *Listeria* Control Model 2012

Purac offers a unique tool – The Purac *Listeria* Control Model 2012. This online model is easy to use and is at the forefront of predictive growth modeling. It is adjustable for eight food characteristics and allows you to predict the effect of Opti.Form Ace P40 in your meat products.

The predicted growth is based on specifically designed and validated *Listeria* challenge studies. Predictions are depicted by the model in two ways.

- The 95% line; 95% of all growth is expected to be more slowly than this line.
- The new "best fit" line; the most probable outcome for growth.

Go to www.purac.com/lcm to find out more.

Predicted effect of Opti.Form Ace P40 on suppression of *Listeria monocytogenes* in cured turkey at 4°C/39°F

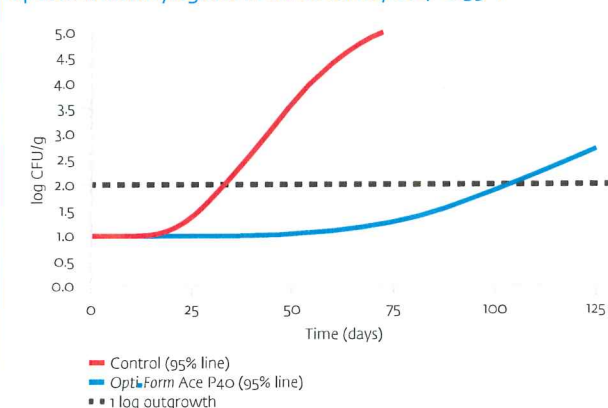


Figure 1

Figure 1 shows the predicted growth of *Listeria* in a typical cured turkey breast formulation. Product parameters used are shown in the table. The control product is expected to reach 1 log of outgrowth not before 32 days (95% line). Addition of 1.5% Opti.Form Ace P40 is expected to reach 1 log outgrowth for at least 100 days (95% line).

Opti.Form® Ace P40	
Form	Liquid
Labeling	Potassium acetate (40%) Potassium lactate (20%)
Target use level	1-2.5%
Sodium impact on product	none

Parameters cured turkey breast (Figure 1)	
Moisture level	70%
Salt	2.1%
pH	6.3
a _w	0.962
Opti.Form Ace P40	1.5%



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Verdad N5 Verdad Powder N6

Nature's choice for *Listeria* control

Benefits



Natural labeling



Inhibit *Listeria* growth



Extend shelf life



Available as powder formulation

About Verdad N5 and powder N6

Verdad N5 and Verdad Powder N6 are natural ingredients developed for natural meat and poultry. They are label friendly ingredients that keep food safe by suppressing the growth of pathogens and a wide range of spoilage bacteria.

Natural labeling

Labeled as vinegar, Verdad N5 and Verdad Powder N6 are produced by the fermentation of corn or cane sugar with specifically selected food cultures. Verdad N5 is approved by the USDA to be used in meat carrying a 'natural' label. It can have a mild vinegar effect on flavor in meat products.

Inhibit *Listeria* growth

Vinegar is a rich source of acetic acid and a well-known inhibitor of microbes and pathogens. In ready-to-eat (RTE) meats, Verdad N5 and Verdad Powder N6 can be used to enhance safety by inhibiting the growth of *Listeria* for over 100 days.

Extend shelf life

Verdad N5 and Verdad Powder N6 inhibit a wide range of spoilage organisms, increasing shelf life in fresh meat. In fresh poultry, Verdad N5 and Verdad Powder N6 can double the shelf life.

Powder formulation for ease of use

Verdad Powder N6 gives the same effect as Verdad N5 at a use level reduction up to 75%. Powder products are less expensive to transport and store and often have other advantages in production.

Expected addition level in a cured ham formulation

Verdad N5	Verdad Powder N6
1.5%	0.4%
2.0%	0.6%
2.5%	0.8%



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Verdad N5 Verdad Powder N6

Nature's choice for *Listeria* control

Total plate counts on fresh chicken breasts

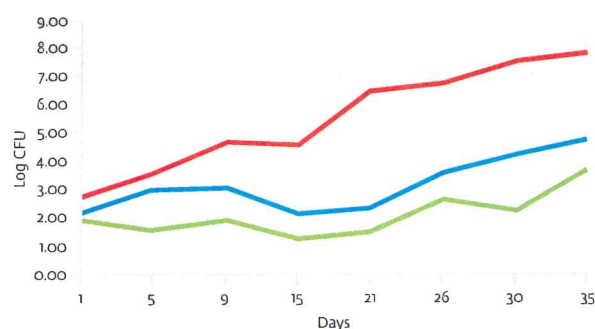


Figure 1

Predicted effect of Verdad N5 on suppression of *Listeria monocytogenes* in cured ham at 4°C/39°F

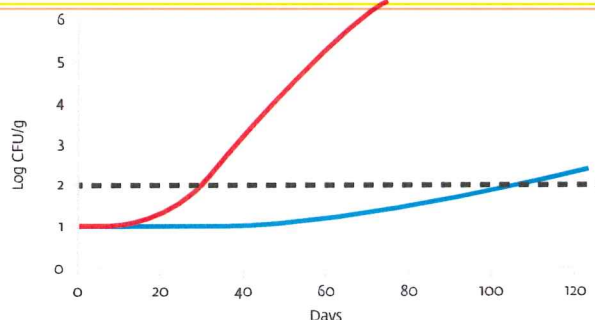


Figure 2

	Verdad N5	Verdad Powder N6
Form	Liquid	Powder
Labeling	Vinegar	Vinegar
Target use level	1.5-2.5%	0.25-0.75%
Sodium impact on product	None	Minor

Shelf life extension

Figure 1 shows the results of a study measuring the influence of Verdad N5 on the total plate count in chicken breast. The chicken breast was vacuum tumbled with a brine solution (13%) containing salt, water and Verdad N5. Addition of Verdad N5 resulted in a shelf life extension of over double the control.

Purac Listeria Control Model 2012

Purac offers a unique tool – The Purac Listeria Control Model 2012. It is adjustable for eight food characteristics and allows you to predict the effect of Verdad N5 and Powder N6 in your meat products. The predicted growth is based on specifically designed and validated Listeria challenge studies. Predictions are depicted by the model in two ways:

- The 95% line; 95% of all growth is expected to be slower than this line.
- The new "best fit" line; the most probable outcome for growth.

Figure 2 shows the predicted growth of *Listeria* in a typical cured ham formulation. Product parameters used are shown in the table. The control product is expected to remain below 1 log outgrowth for at least 29 days (95% line). Addition of 2.1% Verdad N5 or 0.65% of Verdad Powder N6 is expected to reach 1 log outgrowth for at least 100 days (95% line).

Parameters cured ham

Moisture level	70%
Salt	2.1%
pH	6.3
aW	0.972
Verdad N5	2.1%
Verdad Powder N6	0.65%



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Purac offers:

- Improved food safety
- *Listeria* control
- Shelf life extension
- Antimicrobial expertise

Fish safety 'Catchy solutions from Purac'

Today's seafood producers face long production chains and challenging consumers, who demand safer food products with longer shelf life. Fish meat is highly susceptible to microbial growth, including food borne pathogens. Fish products typically do not undergo any form of heat treatment, which is key to killing off pathogens such as *Listeria monocytogenes*.

In 2009, member states of the EU examined over 2,000 items of (mainly smoked) RTE fish products¹. Of these products, 7% were found positive for *Listeria*, demonstrating the importance of including safety hurdles in fish products to reduce bacterial growth and prevent pathogen growth. The Food and Agricultural Organization (FAO) estimates that every million servings of smoked fish results in 0.053 cases of listeriosis annually.²

Listeria monocytogenes is a particularly challenging pathogen as it is ubiquitous by nature and able to grow at refrigerated temperatures. A combination of refrigeration, salt and smoking is not enough to prevent the growth of *Listeria* in fish products. Purac can help to comply with current legislation on *Listeria monocytogenes*. With a wide product range and sound reputation in the food industry,

Purac is the most experienced partner for controlling *Listeria* growth and extending shelf life. We have proven experience with smoked salmon and can share successes in products such as surimi, trout and halibut. Most of our solutions are available as both liquid and powder and can be applied via injection and during both wet or dry curing process.

¹ EFSA 2011, The Community Summary Report on trends and sources of zoonoses and zoonotic agents in the European Union in 2009.

² FAO/WHO 2004. Risk assessment of *Listeria monocytogenes* in ready-to-eat foods.

Opti.Form

With a ten year reputation as the gold standard for *Listeria* control in food products, *Opti.Form* represents a range of solutions based on the organic acid salts of lactate and (di-)acetate. *Opti.Form* provides protection against the outgrowth of *Listeria* with minimal impact on the taste of the finished product.

Figure 1 shows the result of a study examining the effect of 'Opti.Form PD Plus' on the safety of smoked salmon, inoculated with *Listeria monocytogenes*. In the control products, 1 log *Listeria* growth was reached after a few days. When the salmon was formulated with *Opti.Form*, outgrowth was prevented for almost 15 days.

The effect of 'Opti.Form PD Plus' on microbial spoilage in cold smoked salmon is shown in Figure 2. In this study, the time before total plate count reaches 2 log outgrowth is extended by 10 days when *Opti.Form* is added. Sensory analyses concluded that *Opti.Form* did not negatively affect flavor or odor.

Growth of *L. monocytogenes* in smoked salmon at 10°C/50°F

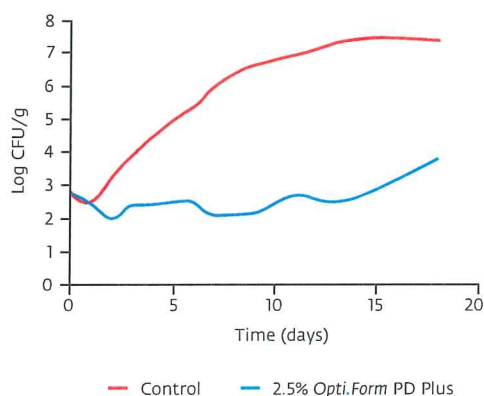


Figure 1

PuraQ Verdad

This line of label friendly and natural ingredients has been developed to increase food safety in products where the listed ingredients must be easily recognizable for consumers. PuraQ Verdad consists of natural ferments and/or vinegar, derived from carefully selected food cultures including organic acids, sugars and peptides.

Purac's *Listeria* Control Model

Purac offers a unique software tool – The *Listeria* Control Model. The model calculates the appropriate amount of Purac solution required to control *Listeria* in food items. The model is adjustable for several formulation parameters including nitrite, salt, moisture and pH. By using specific product parameters, the model will accurately predict *Listeria* suppression in the specific product. This tool enables producers to save development cost, decrease time to market and increase food safety levels.

Total plate count in minced cold smoked salmon at 10°C/50°F

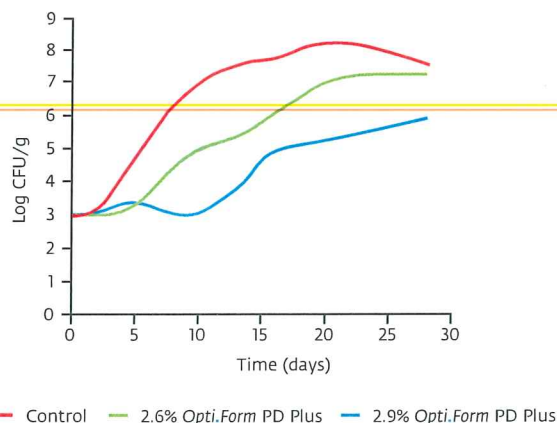


Figure 2



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