P.28 COVID SETS THE TABLE FOR CARNIVOROUS COOKS
P.37 EXPORTERS EXPLORE INDIA'S GROWING MEAT APPETITE
P.86 PURDY WRITES THE BOOK ON CULTIVATED MEAT

02.21 meatingplace.com

meatingplace®

A RARE BREED

WITH A UNIQUE BUSINESS MODEL IN THE SOUTHEAST, FPL FOOD STANDS OUT FROM THE HERD

CLEAN LABEL *ingredients*

AMSA Exclusive: Effect of clean label antimicrobials on the growth of C. perfringens during extended chilling

by **Max Golden, research specialist, Applied Food Safety Laboratory, University of Wisconsin-Madison's Food Research Institute**

Changes in consumer preferences — and recent modifications to the U.S. Department of Agriculture's Food Safety Inspection Service Appendix B — present new challenges for the meat and poultry industry with regard to inhibiting Clostridium perfringens growth during cooling. Although Appendix B provides guidance for controlling this foodborne pathogen, many manufacturers desire to produce products operating outside of the various options included in the document. Additionally, the expense of microbial challenge studies may prohibit smaller manufacturers from producing desired products.

C. perfringens is a potential contaminant that produces heat-resistant endospores in raw meat during the slaughter or dressing process, and in ingredients such as spices and herbs. It grows exceptionally well at 43-47°C (109-117°F), and it can both survive thermal processing and eliminate competitive vegetative microflora. There are an estimated 1 million cases of foodborne illness attributed to this spore-former annually.

Using clean label antimicrobials to extend cooling profiles and inhibit the growth of C. perfringens in meat products can be an effective way to overcome those challenges, especially in uncured meat products. Examples of those conventional and clean label antimicrobials include sodium nitrite or cultured celery, lactate, diacetate, cultured sugars and dried vinegars (see sidebar, p 100).

Here, we'll focus on some of the related research conducted at University of Wisconsin's Food Research Institute (FRI), and highlight successes and failures when using a combined approach of cooling rate and addition of clean label antimicrobials to inhibit C. perfringens growth in uncured meat and poultry products.

More on clean label effects on yield at **meatm.ag/cleanyield**

CLEAN LABEL CONSIDERATIONS

One of the main ways that we control this organism is through stabilization. The 1999 and proposed revised 2017 Appendix B guidelines establish some parameters for this. The latter proposes six cooling options for cured versus uncured meat products to achieve a maximum 1 or 2 log increase of C. perfringens, and identifies

intrinsic properties that play a role in growth inhibition. However, the removal of traditional antimicrobials, such as sodium nitrite, from products presents a substantial challenge when cooling.

Cured products may be cooled for up to 15 hours; however, when sodium nitrite is removed, the time to refrigeration is reduced. The 2017 revision to Appendix B drastically modified Option 2 guidelines where previously, no rate of cooling was specified. The 2017 revision stated that products must be cooled from 120-80°F within 1.5 hours, and 80-55°F within an additional 5 hours. This created rates of cooling in which it is thermodynamically impossible for large-diameter products to achieve.

CURRENT RESEARCH

The modification to Option 2 led our team at FRI to investigate whether the updated guideline was scientifically justified. We investigated how pH and salt would influence the rate of cooling from 120-80°F, and discovered when salt was reduced to 1.2% in combination with a 6.6 pH, we were unable to limit the growth of C. perfringens to less than a 1-log increase. This study supported the 2017 changes to Option 2.

Since combinations of pH and salt were unable to control this pathogen — and cooling rates need to be extended — the third tool in our toolbox is antimicrobials. Clean label antimicrobials may be viable options, and the next two examples provide insight into situations where they do and do not work.

First, we compared a control containing no antimicrobials and 1% of either dry vinegar, dry vinegar/cultured sugar blend, or dry vinegar with fruit and spice extracts at two pH levels. In each case, we found that the addition of the clean label antimicrobial extended the time the products could be cooled from 120-80°F, and that pH was a factor. The dried vinegar/cultured sugar blend was most effective, resulting in less than a 1-log increase over 5 hours of cooling from 120-80°F. The addition of these antimicrobials demonstrates that we can successfully extend cooling times when considering both percent addition and the product pH.

A second example is one in which we were unsuccessful in limiting the growth of C. perfringens. In this research, we compared a control to 2.5% potassium lactate/sodium diacetate (KL-SD), or 0.75% dry vinegar at pH 6.6 and 1%, or 1.5% salt. We also modified the cooling rates from 120-80°F in 3 hours and from 80-55°F in 3.5 hours (as opposed to 5 hours). We found that both the KL-SD and dry vinegar were unable to inhibit C. perfringens growth to less than 1 log.

So why, for example, did the dry vinegar treatment fail, whereas in the first example, we had success? We believe it is a combination of factors. In the second example, we used less dry vinegar, did not cool the product more quickly, and had a high pH. If we had used 1% dry vinegar with a reduced pH, we may have been able to limit growth to less than 1 log at the cooling rates tested. Additionally, in the previous example, we found that a dried vinegar/cultured sugar blend was far more effective than a single antimicrobial alone, and additional research studies involving C. perfringens during cooling at FRI have had similar results.

NEXT STEPS

These UW-FRI studies show that clean label antimicrobials can be used to extend the cooling time of uncured meat and poultry products, and that

SWITCH UP

For many synthetic and conventional antimicrobial ingredients, there are clean label substitutes.

Synthetic/ Conventional	Clean Label
Lactate, proprionate	Cultured sugar, milk or wheat
Diacetate, acetic acid	Vinegar (dry or buffered)
Nitrite	Cultured celery (convert nitrate to nitrite)
Erythorbate, ascorbate	Acerola cherry powder
Nisin (bacteriocins)	Cultured sugar/ dairy solids
Phenolics, flavonoids	Fruit/spice extracts

Read more about poultry clean label at **meatm.ag/cleanpoultry**

> **CLEAN LABEL ANTIMICROBIALS CAN BE USED TO EXTEND THE *cooling time of uncured meat and poultry products.***

combinations of antimicrobials with bactericidal and bacteriostatic effects may lead to further extended cooling. It should be noted that single antimicrobials may require application in greater concentrations, depending on the ingredient. The findings also showed that intrinsic properties such as pH, salt and moisture must be considered, and that the combination of intrinsic properties, cooling rate and antimicrobials (type and concentration) should be used to guide product development.

Current and upcoming research in this area will focus on determining what common organic acids are present in clean label antimicrobials, and the minimum inhibitory concentrations that can be used to extend cooling of uncured meat and poultry products during the first phase of cooking. In addition, more research is underway to validate that clean label antimicrobials demonstrate equivalency, as has been done with conventional versus clean label sources of sodium nitrite.

Finally, more work will need to be done to update the C. perfringens spore baseline populations in raw/cooked meat and poultry products, especially since the current surveys likely are not accurate.

ACKNOWLEDGEMENT

This AMSA RMC presentation was sponsored by the U.S. Department of Agriculture's Agricultural Research Service.

Editor's note: *This is part of an occasional series of exclusive articles provided by authors commissioned by the American Meat Science Association in cooperation with Meatingplace. The article is taken from a presentation given at the AMSA 73rd Reciprocal Meat Conference and International Conference on Meat Science and Technology (ICoMST), which was hosted virtually in August 2020.*