A new one stop solution to extend the shelf life of minced beef

As consumers shop with their eyes, it is crucial for retailers that their meat products keep a bright red colour. Furthermore, flavour also has an impact on the purchase decision of consumers. However, both parameters can deteriorate over time due to oxidation processes.

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Several studies demonstrate that there is a relationship between lipid oxidation (TBARS) and colour deterioration of meat. The reaction products of the lipid oxidation process (free radicals, peroxides) cause off-odour and off-flavour formation and accelerate the oxidation process of oxymyoglobin (bright red colour) to metmyoglobin (grey-brown).

Moreover, the oxymyoglobin oxidation also promotes lipid oxidation as iron ions are produced. Besides the chemical deterioration, micro-organisms also affect the quality, safety and colour of meat products.

In this study, the stabilising properties of NaturCEASE Dry (0.3% and 0.5%) in minced beef were compared against an untreated control, sodium acetate (0.1%) as well as sodium lactate (2.5%) as a positive control.

Mincing of meat speeds up quality deterioration. This is due to the increased surface area and microbial contamination caused by grinding. In the meat industry, antioxidants such as ascorbic acid (E300) are used to delay lipid oxidation, thereby delaying the development of off-flavours and improve colour stability. To ensure products stay fresh and safe to consume, antimicrobials can be used to inhibit growth of micro-organisms. Commonly used synthetic antimicrobials are sodium lactate (E325) and sodium acetate (E262(i)).

However, the use of natural and label friendly food ingredients has become more preferred by consumers. Some natural plant extracts have strong antioxidant properties. Others, also exhibit excellent colour stabilising properties. In addition, Buffered Vinegar Dry has been shown to have a microbial inhibitory effect. Both Buffered Vinegar Dry and natural plant extracts are label friendly alternatives to synthetic ingredients.

Processed meat manufacturers and spice blenders prefer ready-made blends with multiple benefits that are natural and clean label one stop solutions. Hence, the positive effects of natural plant extracts and Buffered Vinegar Dry were combined in one clean label blend – NaturCEASE Dry food safety solution with antioxidant properties.

A combination of different natural plant extracts in one blend offers an optimal delay of lipid oxidation and a more effective meat colour stabilisation. NaturCEASE Dry combines the power of these plant extracts with Buffered Vinegar Dry adding an additional microbial inhibition effect to the blend.

Clean label blend offering multiple benefits

Minced meat without any preservatives nor antioxidants was obtained from a local butcher. In a first trial, TBARS, colour (redness) and appearance were followed up.

In a second trial, microbial growth (Total Plate Count) was measured.

For both trials, the same sample preparation (Table 1) was followed: raw minced beef patties (400g/batch) were made by mixing the treatments (Table 2) with the meat for 2.5 minutes.

Patties were made and packaged at atmospheric conditions in a polypropylene (PP) packaging and stored in the dark over a period of eight days.

For the sensory study, raw minced beef patties (600g/batch) were made by mixing raw minced beef with the treatments, 1.5% salt and 0.1% white pepper for 2.5 minutes (dosage calculated on total product weight). Patties were made and packaged at atmospheric conditions in a polypropylene (PP) packaging and stored in the dark over a period of four days.

Table 1. Sample preparations and storage conditions of meat trials.

	Trial parameters		
	TBARS and colour	Microbial growth	Sensory
Patty weight (g)	40.00	10.00	50.00
Patty size (cm)	5.5	3.0	6.9
Storage conditions (°C)	4	7	4

Table 2. Raw minced beef treatments (dosages calculated on total product weight).

Treatments	Dosage	Active ingredients
Untreated raw minced beef	N/A	No ingredient added
NaturCEASE Dry	0.3%	Dry buffered vinegar, natural plant extract combination
NaturCEASE Dry	0.5%	Dry buffered vinegar, natural plant extract combination
Sodium lactate (E325)	2.5%	Sodium lactate
Sodium acetate (E262(i))	0.1%	Sodium acetate

Protection of colour

Redness of the minced beef treatments decreased as a function of time. The clean label blend NaturCEASE Dry outperformed ($p<0.05$) the untreated minced beef from day one.

From day two, NaturCEASE Dry had significantly ($p<0.05$) higher a* values compared with the positive control treatments sodium acetate and sodium lactate. Appearance of the meat treatments declined over time (Table 3).

Deterioration of appearance shows the same trend as the a* values (Fig. 1). It can be clearly observed that

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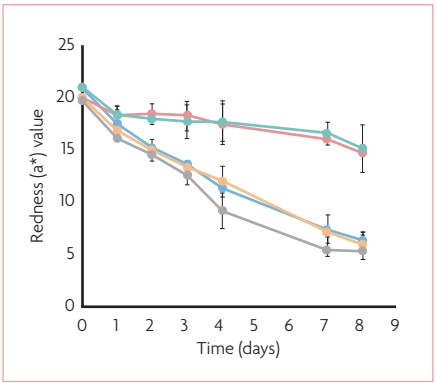


Fig. 1. Average (n=3) redness values of raw minced beef treatments, stored at 4°C in the dark. Error bars represent the standard deviation of the samples.

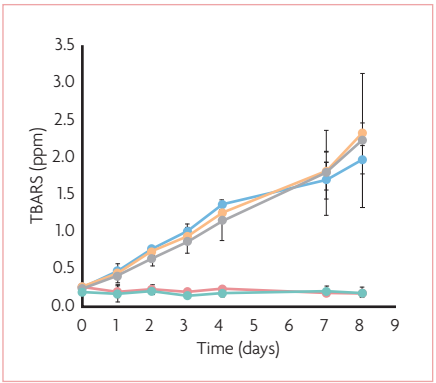


Fig. 2. Average (n=3) TBARS values of raw minced beef treatments, stored at 4°C in the dark. Error bars represent the standard deviation of the samples.

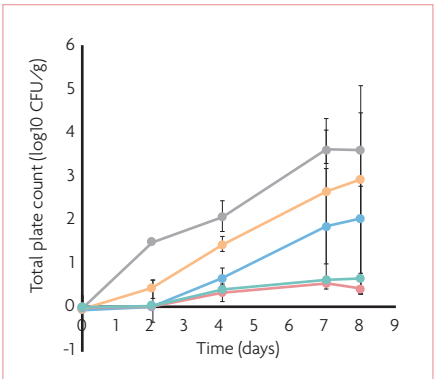


Fig. 3. Average (n=2) change in Total Plate Count (log10 CFU/g) of raw minced beef treatments, stored at 7°C in the dark.

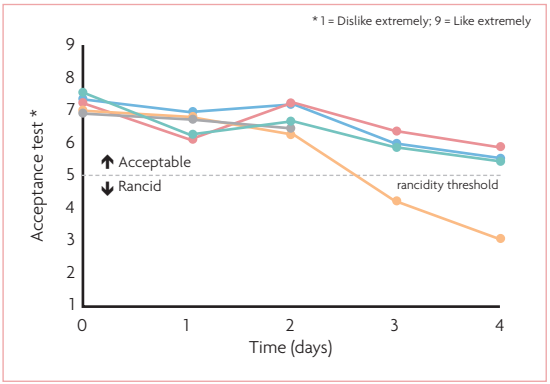


Fig. 4. Acceptance test results of beef patty treatments.

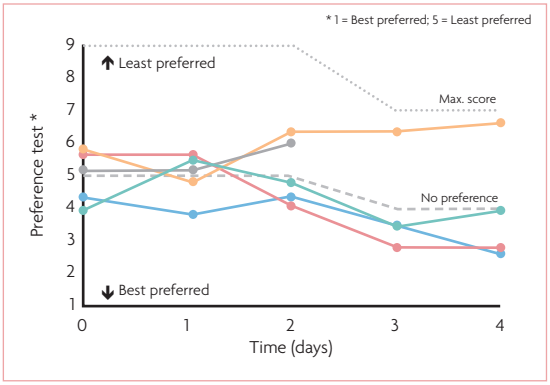
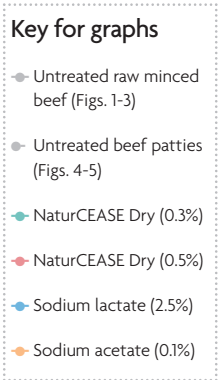


Fig. 5. Preference test results of beef patty treatments.



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the patties treated with NaturCEASE Dry retained their bright red colour until the end of the study.

Protection of freshness

TBARS (secondary oxidation products) did not increase ($p<0.05$) for the raw minced beef treated with NaturCEASE Dry (Fig. 2). All other treatments increased in TBARS. NaturCEASE Dry outperformed ($p<0.05$) the other treatments from day one.

Protection of safety

All treatments inhibited microbial growth (Fig. 3). NaturCEASE Dry outperformed ($p<0.05$) the negative control and sodium acetate from day two and four, respectively.

Even though there was a numerical difference between NaturCEASE Dry and sodium lactate, this difference was not significant. With the exception of day four, sodium lactate performed statistically the same as sodium acetate.

Protection of flavour

The palatability of the beef patties was not negatively affected by any of the treatments as the scores were similar to the untreated beef patties as from day zero to day two. From day three onwards, beef patties treated with sodium acetate were perceived as rancid.

At the end of the study, at day four, beef patties treated with sodium lactate and NaturCEASE Dry were still perceived as acceptable.

At day three and four, the untreated beef patties were not included in the sensory trial due to safety concerns. Therefore, the 'max score' and 'no preference' line in Fig. 5 shifts, as only four treatments were evaluated instead of five.

Conclusion

NaturCEASE Dry extends the shelf life of minced beef by stabilising colour, lipid oxidation and inhibiting microbial growth, without affecting the sensorial properties.

Raw minced meat is more susceptible to quality deterioration compared with whole meat. As the lipid oxidation products (TBARS) increase during the eight days of refrigerated storage in the dark, the appearance, palatability and redness (a* value) of raw minced beef decrease.

Nevertheless, NaturCEASE Dry effectively delayed formation of lipid oxidation products and stabilised the colour. From day one, NaturCEASE Dry had higher ($p<0.05$) redness (a*) values and lower ($p<0.05$) lipid oxidation products (TBARS) compared with the untreated raw minced beef. And from day two, it showed significantly lower microbial growth compared with the untreated control.

The positive control treatments (sodium acetate and -lactate) were outperformed ($p<0.05$) from day one and two, based on TBARS and redness, respectively. From day four, raw minced beef treated with NaturCEASE Dry showed lower ($p<0.05$) microbial growth compared with the sodium acetate treatment. There was no significant difference between sodium lactate and NaturCEASE Dry. NaturCEASE Dry is a multifunctional blend offering convenience to meat manufacturers.

The ideal dosage recommendation would be in the range of 0.3-0.5% (calculated on the total product weight). ■

References are available from the author on request

Table 3. Appearance of raw minced beef treatments, stored at 4°C in the dark.

	Time (days)				
Treatments	**0**	**2**	**4**	**7**	**8**
Untreated raw minced beef					
NaturCEASE Dry (0.3%)					
NaturCEASE Dry (0.5%)					
Sodium lactate (2.5%)					
Sodium acetate (0.1%)