Phosphate reducing potential of apple pomace and coffee silver skin in irish breakfast sausage using a mixture design approach (#494)

Karthikeyan Palanisamy Thangavelu[1, 2], Carlos Álvarez[1], Brijesh Tiwari[1], Ciara K. McDonnell[1, 3], Joseph P. Kerry[2]

[1] Teagasc Food Research Centre, Department of Food Quality and Sensory, Dublin 15, Ireland; [2] University College Cork, School of Food and Nutritional Sciences, Cork, Ireland; [3] Commonwealth Scientific and Industrial Research Organisation, CSIRO Agriculture and Food, Brisbane, Australia

Introduction

Consumers demand for high quality and minimally processed food has resulted in the clean label trend in meat products, whereby the use of additives in the product formulation is avoided. One such recent trend in the meat industry is the removal of phosphate which serves several functions in processed meats such as improving water holding capacity (WHC), emulsion stability, texture and sensory qualities [1]. It remains challenging to replace phosphates in meat products due to its unique mechanistic buffering and chelating properties within the meat cell. Studies have been made to replace phosphates with natural ingredients like starch, proteins and fibres, but this often results in a loss of quality [2]. Apple pomace powder and coffee silver skin powder are fibre-rich food by-product substances that could serve as phosphate replacers in sausages. Hence, the objective of the study was to make a detailed characterisation and optimisation of apple pomace powder and coffee silver skin powder as phosphate replacers in breakfast sausages using mixture design software approach.

Methods

Two pork loins (pH > 5.5) per block were purchased (Gleeson Butchers, Ireland). Back fat was separated from the lean meat and each component was minced (Meat Grinder MG510, Kenwood, UK). All sausage formulations (1Kg) were made containing lean pork meat (58%), pork back fat (20.35%), water/ice (13.45%), rusk (5.75%) and seasoning (1.45%) along with the mixture designed ingredients (1%) as described in Table 1 (Design Expert v. 10, Minneapolis, USA).

The ingredients were mixed together in a mixer and placed in collagen casing of 1.5cm diameter using the same meat mincer with a sausage filler attachment. The sausages were then covered in cling film on a retail tray and stored at 4°C for 24h before being analysed for water holding capacity (WHC), texture profile analyses (TPA), colour (L*, a* and b*), low-field nuclear magnetic resonance (LF-NMR) and proximate composition. The factor response characteristics of ingredients were studied using I-optimal design type with quadratic design model for three ingredient mixture systems with three meat blocks.

Results

Three constraints were employed for ingredients, (i) sodium tripolyphosphate (≤0.5); (ii) apple pomace (X_2) (≤1); (iii) coffee silver skin (X_3) (≤1). No significant changes were observed in the proximate analysis of the raw sausages except for the fibre contents. It was also observed that NMR relaxation times were not significantly affected by formulations ($p>0.05$). However, the response values showed that there is significant change ($p<0.05$) in the values of WHC, cook loss, colour and textural parameters of each run. Results showed (Table 1) that apple pomace and coffee silver skin on their own did not perform well when phosphate is completely removed (treatment run 1, 2, 3, 7, 8, 10 and 15). However, the WHC and cook loss values of treatment run 11 and 12 (Table 1) were 88.63% & 5.58 % and 87.53% & 5.93%, respectively, indicating that a reduction in phosphate content can be made resulting in better WHC and low cook loss values.

Conclusion

The model successfully indicated that almost a 50% reduction in phosphate could be achieved when using clean label ingredients, without any loss in WHC and cook loss quality.

Acknowledgements

The funding for this research was kindly provided by Teagasc and the Walsh Fellowship Scheme.

References

1. Nguyen, H.B.S.L., R. Gal and F. Bunka, 2011. Use of phosphates in meat products. Afr. J. Biotechnol, 10, 19874-19882.
2. Resconi, V. C., Keenan, D. F., Garcia, E., Allen, P., Merry, J. P., & Hamill, R. M. (2016). The effects of potato and rice starch as substitutes for phosphate in and degree of comminution on the technological, instrumental and sensory characteristics of restructured ham. Meat Sci., 121, 127-134.

Notes

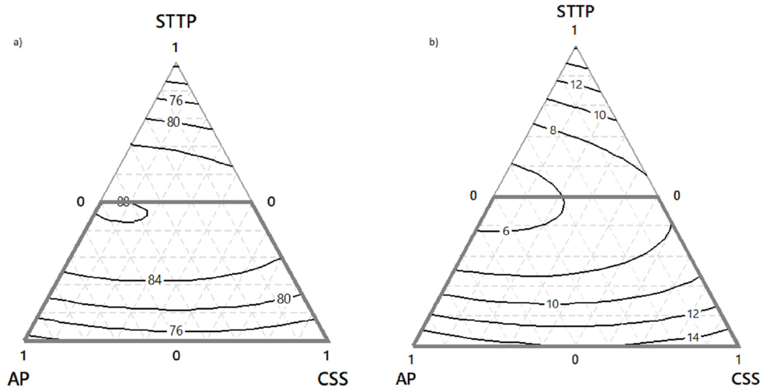

Figure 1 Contour plot for (a) WHC (%) and (b) Cook loss (%) influenced by Sodium Tripolyphosphate (STTP); Apple pomace (AP) and Coffee silver skin (CSS).

		Experimental Design			Results	
Meat Blocks	Treatment	Sodium Tripolyphosphate (%) (X_1)	Apple Pomace (%) (X_2)	Coffee Silver Skin (%) (X_3)	Water Holding Capacity (%)	Cook Loss (%)
	1	0	1	0	69.58	16.12
	2	0	1	0	68.61	17.99
	3	0	0	1	69.21	17.95
	4	0.50	0.23	0.27	85.17	8.3
1	5	0.20	0.40	0.40	80.87	11.03
	6	0.20	0.40	0.40	77.7	13.42
	7	0	0	1	72.7	15.87
	8	0	0.49	0.51	71.63	16.73
	9	0.26	0.68	0.06	87.16	5.75
	10	0	0.24	0.76	77.46	9.32
2	11	0.33	0.48	0.19	88.63	5.58
	12	0.26	0.68	0.06	87.53	5.93
	13	0.50	0	0.50	88.19	6.34
	14	0.50	0.50	0	86.54	5.79
	15	0	0.73	0.27	76.87	11.29
3	16	0.26	0	0.74	84.19	8.11
	17	0.26	0	0.74	81.09	9.96
	18	0.26	0.19	0.55	86.68	7.26

Where $X_1 + X_2 + X_3 = 1$ %, $0=X_1=0.5$; $0= X_2, X_3 = 1$

Table 1 Experimental design of mixture components in sausage formulations

Notes