51st International Congress of Meat Science and Technology
August 7-12, 2005 – Baltimore, Maryland USA

EVALUATION OF THE FUNTIONAL PROPERTIES OF NON-MEAT INGREDIENTS IN COOKED CHICKEN FILLETS

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Key Words: chicken, phosphate, non-meat ingredients.

Introduction

Poultry consumption has increased at a faster rate than other meat species due largely to its low fat content, health promoting image (Muguruma *et al.*, 2003) as well as convenience and ease of preparation (Anderson and Shugan, 1991). Salt and phosphate addition during marination of chicken has been shown to increase water holding capacity (Barbut 2002) and generates a more tender and juicy product with enhanced yields (Shahidi & Synowiecki 1997). However the presence of excessive amounts of phosphate can lead to organoleptic defects (texture and flavour) and negatively influence calcium, iron and magnesium balances in the body which can increase the risks of bone disease (Shahidi & Synowiecki 1997). Addition of alternative ingredients such as proteins and polysaccharides may also enhance meat cook yields and water holding capacity of poultry products (McKee and Alvardo, 2004; Swenson and Katen). Moreover, increasing EU consumer demands for meat products possessing a clean ingredient listing are leading to a shift in the use of artificial and chemically modified ingredients to more natural adjuncts. A study by Kerry (1996) showed that selected physically modified proteins and starches increase the water holding capacity of cooked cured ham products similar to phosphates and thus forms the basis for this research.

Objectives

To assess a range of test brines containing added proteins or starches in fresh chicken fillets and to compare final cooked yields of these test samples against controls with and without added tripolyphosphate.

Methodology

10 Chicken fillets (mean = 100g) were injected (15%) with either a control brine (A) consisting of water and sodium chloride (1.0% residual in the meat) or a control (B) containing water, NaCl and tripolyphosphate (TPP) with the latter two ingredients being incorporated in final meat products at residual levels of 1.0% and 0.3%, respectively. The % ingredients in the brine were calculated as follows: [(100 + IR) * % RIL] / IR. (where IR = injection rate and RIL = residual ingredient level in the injected meat). A range of test proteins including Na caseinate, Ca caseinate, physically modified high gelling whey

protein concentrates –WPCs- 35% WPC A and 35% WPC B (Dairygold Co Operative Society Ltd. Mitchelstown, Co. Cork, Ireland.), 90% Soya isolate 548 (Protein International, St Louis, MO, USA.), 75% WPC (Denmark Proteins AS. Nr Vium, DK-6920, Videbaek, Denmark.) and 76% egg albumin (Lactosan (UK) Ltd, 5 Swingbourne Drive, Springwood Industrial Estate, Braintree, UK) were added to test brines as a replacement for TPP and compared against controls (A and B). Breast fillets were injected (Inject Star, model: BI-18) to a target of 15% with test ingredients at a residual level of 1.0%. with the exception of 35% WPCs (A and B) which were added at residual levels of 1, 2 and 3%. Similarly, a range of native test starches including: Pea A -inner fibre-, Pea B -outer fibre- (Cosucra SA., Rue de la Sucrerie 1, B-7740 Warcoing, Belgium), Potato A -physically modified- and Potato B -physically modified- (National Starch and Chemical Company, Prestbury Court, Greenscourt Business Park, 333 Styal Road, Manchester, M22 5LW, UK.) were assessed in test fillets at residual levels of 0.5% and 1.0% and compared against controls. After injection, chicken breasts were massaged for 10 min at low speed using a paddle mixer (Kenwood, model: Chef KM 300). Treatments were cooked at 110^{o}C for 15 min to a minimum core temperature of 74°C in a steam cabinet (Zanussi, model: IOGN1/1) and subsequently cooled at 2°C x 16h prior to weighing. All treatments were carried out in triplicate. Yield and delta yield values were calculated according the following formulae:

% Green Yield = (Cooked Weight – Original Weight) X 100

Delta Yield (for each batch) = Test Ingredient Yield – Control Yield

SPSS statistical computer software package (SPSS version 8, Ireland, 79 Old Kilmainham Road, Dublin 8, Ireland.) was employed in this study. This was a repeated Measures design with one “between-subjects” factor. The effects of a particular food/ingredient was investigated using a relevant SPSS output, which included tests for “within-subjects” effects (i.e. effect of cooking), tests for “between-subjects” effects and multiple comparisons within each day. Tukey’s test was used to adjust for multiple comparisons.

Results & Discussion

Cook yield values and delta values (test – control) are presented for test protein ingredients (Table 1) and polysaccharides (Table 2). Delta values were calculated in order to minimise the effect of cooking variability. Results showed that the addition of 0.3% residual TPP (Control B) increased cook yields on average by 10% over control A. With the exception of Na caseinate, all non meat proteins increased cook yields over control A (Table 1). However, only the physically modified high gelling 35% WPCs (A and B) at a 3% residual level and 75% WPC at a 2% residual level increased cook yields over control B. 75% Egg albumen at a 1% residual level also increased cook yield over controls (A and B) however it was quite difficult to hydrate and had a tendency to foam. In a number of instances test proteins were too difficult to solubilise or too viscous to inject/pump through the injector and were rejected (N/A). Na caseinate produced the most negative delta yield of all ingredients assessed and is in agreement with Kerry (1996). All test polysaccharides, increased cook yield versus control A, with pea starch A and potato starch A giving a greater yield than control B containing TPP (Table 2).

Conclusions

The addition of 0.3% residual TPP increase cook yields on average by 10%. Non meat proteins 35% protein WPCs (A and B) at a 3% level, 75% WPC at a 2% level gave yields equal to control B. Na caseinate gave the lowest cook yields of all test ingredients assessed. Polysaccharides also increased the yield of chicken fillets versus control A with pea starch A and potato starch A giving improved yields over control B. Results show that there is a potential to utilise physically modified proteins and polysaccharides as TPP replacers in cooked poultry processing.

References

Anderson, E.W. & Shugan, S.M. (1991). Repositioning for changing preferences: The case of beef versus poultry. Journal of Consumer Research, 18 219–232.

Barbut, S. (2002). Poultry Products processing: An Industry Guide. CRC Press. 259.

Keeton, J.T. (2001). Formed and Emulsion Products. Chapter 12 in: Poultry Meat Processing. Edited by Sams, A.R. CRC Press, 205–206.

Kerry, J.F. (1996). Evaluation of the functionality of added non-meat proteins and polysaccharides in the manufacture of reformed cured meats. PhD Thesis. University College Cork.

Muguruma, M., Tsuruoka, K., Katayama, K., Erwanto, Y., Kawahara, S., Yamauchi, K., Sathe, S.K., and Soeda, T. (2003). Soya bean and milk proteins modified by transglutaminase improves chicken sausage texture even at reduced levels of phosphate. Meat Science, 63 191–197.

McKee, S. and Alvarado, C. (2004) Marination and Brining of Poultry Products: Value Added. AMSA 57th Annual Reciprocal Meat Conference June 20–23, 2004, Lexington, Kentucky 129–136.

Shahidi, F., and Synowiecki, J. (1997). Protein hydrolazates from seal meat as phosphate alternatives in food processing applications. Food Chemistry, 60, 29–32.

Swenson, K.J. and Katen, T. (2004) Starch Applications in Meat Products Proceedings of the AMSA 57th American Meat Science Association Reciprocal Meat Conference June 20–23, 2004, Lexington, Kentucky 89–90.

Tables and Figures

Table 1

Mean (n = 30) (i) % yield and (ii) delta (test – control) values of test chicken fillets containing added non meat proteins and controls containing 0 or 0.25% residual TPP (controls A and B, respectively).

% added	Sodium caseinate	Calcium caseinate	WPC 35 A	WPC 35 B	Soya	WPC 75	Pea	Egg Albumin
(i)								
Con A	77.1±2.1[a]	80.2±3.1[a]	78.4±2.6[a]	78.6±1.5[a]	79.1±2.5[a]	77.0±3.0[a]	77.2±3.8[a]	77.1±3.1[a]
Con B	86.9±3.3[b]	91.1±4.2[b]	89.1±2.4[b]	89.1±2.0[b]	90.3±2.0[b]	86.0±2.8[b]	86.4±3.4[b]	86.4±2.1[b]
1.0	68.8±3.3[c]	81.6±2.7[a]	82.3±2.6[b]	84.2±3.0[b]	86.2±1.6[b]	84.6±2.4[b]	84.9±2.1[b]	88.1±2.4[c]
2.0	N/A	N/A	85.1±3.3[b]	88.6±2.8[b]	N/A	86.4±1.9[c]	N/A	N/A
3.0	N/A	N/A	89.5±3.5[b]	89.8±2.1[c]	N/A	N/A	N/A	N/A
(ii)								
Con B	9.9	10.9	10.7	10.5	11.2	9.0	9.2	9.2
1.0	- 8.3	1.4	3.9	5.6	7.1	7.6	7.7	**11.0**
2.0	N/A	N/A	6.7	10.0	N/A	**9.4**	N/A	N/A
3.0	N/A	N/A	**11.1**	**11.2**	N/A	N/A	N/A	N/A

Control A (Con A) = 1% residual NaCL, Control B (Con B) = 1% NaCL and o.3% 0.3% residual phosphate

Different letters (a-c) within the same column indicate significant ($p<0.05$) differences

N/A = test ingredients insoluble or unacceptable for injection.

Table 2

Mean (n = 30) (i) % yield and (ii) delta (test - control) of test chicken fillets containing added polysaccharides and controls containing 0 or 0.25% residual TPP (a and b, respectively).

% added	Pea A (inner fibre)	Pea B (outer fibre)	Potato A	Potato B
(i)				
Con A	77.1±2.3[a]	77.8±3.1[a]	77.3±2.6[a]	78.0±2.0[a]
Con B	87.0 ±2.6[b]	87.3±2.2[b]	88.3±3.0[b]	88.4±1.9[b]
0.5	84.4±2.4[b]	81.8±2.2[b]	83.5±3.3[b]	88.1±2.7[b]
1.0	87.4±1.9[c]	82.8±2.5[b]	89.0±3.1[c]	87.0±1.6[b]
(ii)				
Con B	9.8	9.5	11.0	10.7
0.5	7.3	4.0	6.1	10.0
1.0	**10.1**	5.0	**10.7**	9.0

Control A (Con A) = 1% residual NaCL, Control B (Con B) = 1% NaCL and o.3% 0.3% residual phosphate

Different letters (a-c) within the same column indicate significant ($p<0.05$) differences

N/A = test ingredients insoluble or unacceptable for injection.

Table 3

Mean (n = 30) (i) % yield and (ii) delta (test - control) of test chicken fillets containing added polysaccharides and controls containing 0 or 0.25% residual TPP (a and b, respectively).

% added	Pea A (inner fibre)	Pea B (outer fibre)	Potato A	Potato B
(i)				
Con A	77.1±2.3[a]	77.8±3.1[a]	77.3±2.6[a]	78.0±2.0[a]
Con B	87.0 ±2.6[b]	87.3±2.2[b]	88.3±3.0[b]	88.4±1.9[b]
0.5	84.4±2.4[b]	81.8±2.2[b]	83.5±3.3[b]	88.1±2.7[b]
1.0	87.4±1.9[c]	82.8±2.5[b]	89.0±3.1[c]	87.0±1.6[b]
(ii)				
Con B	9.8	9.5	11.0	10.7
0.5	7.3	4.0	6.1	10.0
1.0	**10.1**	5.0	**10.7**	9.0

Control A (Con A) = 1% residual NaCL, Control B (Con B) = 1% NaCL and o.3% 0.3% residual phosphate

Different letters (a-c) within the same column indicate significant ($p<0.05$) differences

N/A = test ingredients insoluble or unacceptable for injection.