EFFECT OF OYSTER SHELL CALCIUM POWDER ON QUALITY PROPERTIES OF RESTRUCTURED PORK HAM

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Abstract – This study was conducted to evaluate effects of oyster shell calcium powder (OSCP) addition on quality properties of restructured pork hams to substitute the phosphates as a curing agent. Restructured pork hams were processed in 7 treatments : T1(no additive), T2(sodium tripolyphosphate 0.3%), T3(NaCl 1.5%), T4(NaCl 1.5% + whey protein 0.5%), T5(NaCl 1.5% + whey protein 0.5% + OSCP 0.15%), T6(NaCl 1.5% + whey protein 0.5% + OSCP 0.3%), T7(NaCl 1.5% + whey protein 0.5% + OSCP 0.5%). In the proximate analysis, there were significant($p<0.05$) differences in moisture and protein contents of restructured pork hams among treatments. Also, addition of OSCP, significantly($p<0.05$) increased the ash content of pork hams. Addition of OSCP significantly($p<0.05$) increased pH and processing yield values, but cooking loss values of restructured pork hams were not affected by OSCP addition. In the surface color, addition of OSCP had no effect on Hunter a and b values of restructured pork hams except Hunter L value. In the texture profile analysis, addition of 0.3% or 0.5% OSCP significantly($p<0.05$) increased the springiness value of pork hams. However, there were no significant differences in shear force and cohesiveness values of pork hams among treatments. As a result, oyster shell calcium powder, when whey protein(0.5%) was simultaneously added to restructured pork hams at reduced level of salt(1.5%), could be used as a substitute for phosphates and optimal addition level seemed to be 0.3% in processing of restructured pork hams.

Key Words – Oyster shell calcium powder, Inorganic polyphosphate, restructured pork ham

I. INTRODUCTION

Phosphates, like many other curing agents, perform multiple functions when added to meat products. One of the most important functions of phosphates is the increasing solubility of meat proteins to bind and retain water in meat emulsion. The result of improved water retetion is not only improved cooking yields, but also improved product texture, tenderness and juiciness(Xiong, 2005). Although there are many forms of the phosphates that may be used in cured meat, the regulations do not differentiate between the various phosphates and phosphate blends. All are restricted to 0.5% based on finished product weight when used to reduce moisture loss, to protect flavor, or as a cure accelerator(USDA-FSIS, 1982).

Shell contains calcium carbonate($CaCO_3$) as the main component and can be used as a source of calcium. By heat treatment, $CaCO_3$ in the shell is converted to CaO, which exhibits antibacterial activity(Sawai et al., 2001). Oyster shell calcium powder was applied to prepare noodles, fried chicken, sardine ball(Suhara, 1995), Kimchi(Choi et al., 2006), tofu(Kim et al., 2007) and pork sausage(Lee et al., 2011) for quality improvement or extension of shelf life.

However, the effect of oyster shell calcium powder addition on functional properties of meat products was not fully studied yet. Therefore, this study was conducted to evaluate effects of oyster shell calcium powder (OSCP) addition on quality properties of restructured pork ham to substitute the phosphates as a curing agent.

II. MATERIALS AND METHODS

Certified organic grade vacuum packed, refrigerated lean pork was obtained from Goesan Doorae Food Inc.(Goesan, Korea). Restructured pork hams were processed in 7 treatments: T1(no additive), T2(sodium tripolyphosphate 0.3%),

T3(NaCl 1.5%), T4(NaCl 1.5% + whey protein 0.5%), T5(NaCl 1.5% + whey protein 0.5% + OSCP 0.15%), T6(NaCl 1.5% + whey protein 0.5% + OSCP 0.3%), T7(NaCl 1.5% + whey protein 0.5% + OSCP 0.5%). Basic formulations for restructured pork hams were as followed: lean pork(88.3%), water(8.8%), fructo-oligosaccharide (0.7%), glutinous rice powder (1.8%) and seasoning(0.3%). The mixed blends were stuffed into a retainer($18.0 \times 6.0 \times 4.5 cm^3$), dried(25min), smoked(55℃ for 13min) by sawdust, and then cooked to an internal temperature of 72℃ in a smokehouse(Bastramat 1500; Bayha & Strackbein Gmbh, Amsberg, Germany). The cooked hams were cooled with water spray and kept at 4℃ for 12 hr before vacuum packaging. The samples were stored at 4℃ and quality properties were evaluated. The results were analyzed using the SAS(2002) program and the significance was defined at $p<0.05$.

III. RESULTS AND DISCUSSION

In the proximate analysis(Table 2), there were significant($p<0.05$) differences in moisture and protein contents of restructured pork hams among treatments. Also, addition of oyster shell calcium powder(OSCP) significantly($p<0.05$) increased the ash content of pork hams. Addition of OSCP significantly($p<0.05$) increased pH and processing yield values, but cooking loss values of restructured pork hams were not affected by OSCP addition(Table 3).

Table 1. Experimental design for restructured pork hams

Items***	STPP*	NaCl	Whey protein	OSCP**
T1	-	-	-	-
T2	0.3%	-	-	-
T3	-	1.5%	-	-
T4	-	1.5%	0.5%	-
T5	-	1.5%	0.5%	0.15%
T6	-	1.5%	0.5%	0.3%
T7	-	1.5%	0.5%	0.5%

* Sodium tripolyphosphate

** Oyster shell calcium powder

*** T1(no additive), T2(STPP 0.3%), T3(NaCl 1.5%), T4(NaCl 1.5% + whey protein 0.5%), T5(NaCl 1.5% + whey protein 0.5% + OSCP 0.15%), T6(NaCl 1.5% + whey protein 0.5% + OSCP 0.3%), T7(NaCl 1.5% + whey protein 0.5% + OSCP 0.5%)

Table 2. Effect of oyster shell calcium powder addition on proximate analysis of restructured pork hams*

Items	Moisture(%)	Protein(%)	Fat(%)	Ash(%)
T1	67.61 ±0.60^{e}	26.86 ±0.76^{a}	4.87 ±0.03^{a}	0.75 ±0.16^{d}
T2	67.85 ±0.36^{e}	26.39 ±0.61^{a}	4.80 ±0.26^{a}	0.94 ±0.09^{d}
T3	70.03 ±0.55^{d}	24.92 ±1.35^{b}	3.69 ±0.53^{b}	1.36 ±0.16^{c}
T4	70.51 ±0.97^{cd}	23.96 ±0.29^{bc}	4.48 ±0.38^{a}	1.73 ±0.16^{b}
T5	71.16 ±0.36^{bc}	23.05 ±0.37^{cd}	3.89 ±0.10^{b}	1.91 ±0.12^{b}
T6	71.68 ±0.37^{ab}	22.38 ±0.65d^{de}	3.65 ±0.31^{b}	2.3 ±0.11^{a}
T7	72.21 ±0.37^{a}	21.57 ±0.52^{e}	3.75 ±0.10^{b}	2.33 ±0.15^{a}

* Treatments are the same as in Table 1.

a-e Means±SD with different superscription in the same column are significantly different($p<0.05$).

Table 3. Effect of oyster shell calcium powder addition on quality properties of restructured pork hams*

Items	pH	WHC(%)**	Cooking loss(%)***	Processing yield(%)
T1	6.02 ±0.02^{cd}	66.61 ±0.54^{b}	3.77 ±0.16^{a}	90.45 ±0.07^{d}
T2	5.90 ±0.00^{e}	74.32 ±3.38^{a}	2.92 ±0.07^{b}	91.25 ±1.27^{d}
T3	5.95 ±0.02^{de}	70.8 ±1.31^{ab}	3.51 ±0.24^{a}	96.04 ±0.69^{c}
T4	6.06 ±0.00^{c}	71.2 ±1.26^{ab}	3.73 ±0.16^{a}	97.29 ±0.38^{b}
T5	6.37 ±0.02^{b}	72.05 ±1.47^{ab}	3.78 ±0.23^{a}	98.41 ±0.18^{a}
T6	6.54 ±0.01^{a}	72.68 ±3.20^{ab}	3.46 ±0.01^{a}	98.90 ±0.10^{a}
T7	6.59 ±0.10^{a}	71.00 ±2.49^{ab}	3.59 ±0.16^{a}	99.04 ±0.10^{a}

* Treatments are the same as in Table 1.

** Water holding capacity

*** Consumer cook test weight loss

a-e Means±SD with different superscription in the same column are significantly different($p<0.05$).

In the surface color(Table 4), addition of OSCP had no effect on Hunter a and b values of restructured pork hams except Hunter L value. In the texture profile analysis(Table 5), addition of 0.3% or 0.5% OSCP significantly($p<0.05$) increased the springiness value of pork hams. However, there were no significant differences in shear force and cohesiveness values of pork hams among treatments.

Table 4. Effect of oyster shell calcium powder addition on Hunter color of restructured pork hams*

Items	Hunter color[1)]		
	L	a	b
T1	78.17 ±3.50[a]	4.75 ±0.98[ab]	16.54 ±0.47[a]
T2	78.07 ±1.80[a]	4.94 ±0.65[ab]	16.5 ±0.22[a]
T3	70.51 ±0.39[c]	3.72 ±0.41[c]	15.71 ±0.64[b]
T4	73.59 ±0.71[b]	4.82 ±0.12[ab]	15.68 ±0.08[b]
T5	74.46 ±1.10[b]	5.34 ±0.31[a]	16.54 ±0.18[a]
T6	68.88 ±0.24[c]	4.44 ±0.07[b]	15.73 ±0.08[b]
T7	69.88 ±0.72[c]	5.03 ±0.14[ab]	16.4 ±0.09[a]

* Treatments are the same as in Table 1.
[a-c] Means±SD with different superscription in the same column are significantly different($p<0.05$).
[1)] L:lightness, a:redness, b: yellowness.

Table 5. Effect of oyster shell calcium powder addition on texture profile analysis of restructured pork hams*

Items	Shear Force (g)	Hardness (kg)	Cohesiveness (%)	Springiness (%)	Chewiness
T1	49.00 ±16.97	2.10 ±0.42[ab]	34.61 ±5.85	49.17 ±5.61[bc]	3.55 ±0.84[ab]
T2	36.75 ±21.28	1.78 ±0.34[b]	29.03 ±4.09	44.28 ±6.94[c]	2.27 ±0.62[b]
T3	38.20 ±20.43	2.8 ±1.17[ab]	26.39 ±4.92	42.75 ±13.2[c]	3.11 ±1.32[ab]
T4	37.20 ±16.93	2.99 ±1.25[a]	27.14 ±4.53	40.66 ±6.66[c]	3.24 ±1.21[ab]
T5	49.00 ±4.76	2.14 ±0.69[ab]	27.42 ±5.99	48.38 ±13.21[bc]	2.69 ±0.71[ab]
T6	43.40 ±14.57	2.16 ±0.41[ab]	25.89 ±9.10	65.77 ±20.49[ab]	3.58 ±1.53[ab]
T7	37.40 ±11.88	1.87 ±0.42[ab]	28.8 ±5.74	79.94 ±15.34[a]	4.15 ±0.86[a]

* Treatments are the same as in Table 1.
[a-c] Means±SD with different superscription in the same column are significantly different($p<0.05$).

IV. CONCLUSION

Oyster shell calcium powder, when whey protein(0.5%) was simultaneously added to restructured pork hams at reduced level of salt(1.5%), could be used as a substitute for phosphates and optimal addition level seemed to be 0.3% in processing of restructured pork hams.

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