EFFECT OF REPLACING PORK FAT WITH VEGETABLE OILS ON QUALITY PROPERTIES OF PORK SAUSAGES

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Abstract – This study was conducted to evaluate effect of replacing pork fat with vegetable oils mixture on quality properties of pork sausages. Emulsion-type pork sausages were processed in 6 treatments: T1(pork fat 20%), T2(pork fat 10% + grape seed oil 2% + olive oil 4% + canola oil 4%), T3(grape seed oil 4% + canola oil 16%), T4(grape seed oil 4% + olive oil 4% + canola oil 12%), T5(grape seed oil 4% + olive oil 8% + canola oil 8%), T6(grape seed oil 4% + olive oil 12% + canola oil 4%). In the proximate analysis, there were significant($p<0.05$) differences in moisture, protein and fat contents of pork sausages among treatments. Also, vegetable oils replacement significantly($p<0.05$) decreased the ash content of pork sausages, but differences were small. Vegetable oil replacement significantly($p<0.05$) increased water holding capacity, but decreased cooking loss of pork sausages. Cholesterol value of pork sausages tended to decrease by vegetable oils replacement. In the texture profile analysis, hardness, springiness and chewiness values of pork sausages were significantly($p<0.05$) decreased by vegetable oils replacement. As a result, vegetable oils may be possibly applied as pork fat substitute in emulsion-type pork sausages since vegetable oils replacement could improve some functional properties of sausages.

Key Words – Pork sausage, Quality property, Vegetable oil

I. INTRODUCTION

In general, sausages possess so high fat content that they may contain animal fat up to 30%. Fats are of vital importance as a source of energy and essential fatty acids(Vural et al.[1]). Fats in meat products also play important roles in stabilizing meat emulsions, reducing cooking loss, improving water holding capacity and providing juiciness and hardness(Pietrasik and Duda[2]; Yoo et al.[3]). However, high animal fat contents provide high amounts of saturated fatty acids and cholesterol. High animal fat diets may be associated with several types of obesity, hypertension, cardiovascular diseases and coronary heart diseases(Özvural and Vural[4]). So there is a growing demand by consumers for healthier products which in turn stimulate the developments of meat products with reduced fat content and altered fatty acid profiles(Colmonero[5]). Vegetable oils are free of cholesterol and have a higher ratio of unsaturated to saturated fatty acids than animal fats (Liu et al.[6]). Vegetable oils such as olive oil and canola oil have also been used as partial substitutes of pork backfat in low-fat frankfurters and other type of cooked products(Park et al.[7]; Pappa et al.[8]). Because vegetable oils differ considerably in physical properties such as color, flavor, free fatty acids and fatty acid composition, different oils could have different effects on the quality characteristics and nutritional value of meat products. However, effect of replacing animal fat with vegetable oil mixtures on quality of sausages was not fully studied yet. Therefore, this study was conducted to evaluate effect of replacing pork fat with vegetable oils mixture on quality properties of pork sausages.

II. MATERIALS AND METHODS

Certified organic grade vacuum packed, refrigerated lean pork and frozen pork backfat were obtained from Hansalimfood Agr. Corp.(Goesan, Korea). Emulsion-type pork sausages were processed in 6 treatments(Table 1).

Basic formulations for emulsion-type pork sausages were as followed: lean pork(60%), water(20%), salt(1.3%), sodium tripolyphosphate(0.2%), natural seasoning(0.07%), fructo-oligosaccharide (0.7%), glutinous rice powder (1.7%) and seasoning(0.6%). The mixed emulsions were stuffed into a collagen casing(2.0cm of diameter, Nippi Collagen Industry, Shizuoka, Japan), 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 sausages 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[9] 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, protein and fat contents of pork sausages among treatments. Also, vegetable oils replacement significantly($p<0.05$) decreased the ash content of pork sausages, but differences were small. Vegetable oils replacement significantly($p<0.05$) increased water holding capacity, but decreased cooking loss of pork sausages(Table 3). Cholesterol value of pork sausages tended to decrease by vegetable oils replacement.

Table 1. Experimental design for pork sausages

Items*	Pork fat	Grape seed oil	Olive oil	Canola oil
T1	20%	-	-	-
T2	10%	2%	4%	4%
T3	-	4%	-	16%
T4	-	4%	4%	12%
T5	-	4%	8%	8%
T6	-	4%	12%	4%

* T1(pork fat 20%), T2(pork fat 10% + grape seed oil 2% + olive oil 4% + canola oil 4%), T3(grape seed oil 4% + canola oil 16%), T4(grape seed oil 4% + olive oil 4% + canola oil 12%), T5(grape seed oil 4% + olive oil 8% + canola oil 8%), T6(grape seed oil 4% + olive oil 12% + canola oil 4%)

In the texture profile analysis(Table 4), hardness, springiness and chewiness values of pork sausages were significantly($p<0.05$) decreased by vegetable oils replacement.

Table 2. Effect of replacing pork fat with vegetable oils on proximate analysis of pork sausages*

Items	Moisture(%)	Protein(%)	Fat(%)	Ash(%)
T1	62.18 ±0.31^{a}	24.61 ±4.55^{a}	11.35 ±4.27^{c}	1.85 ±0.11^{a}
T2	60.79 ±0.26^{b}	21.37 ±1.45^{abc}	15.89 ±1.52^{b}	1.87 ±0.05^{a}
T3	58.95 ±0.63^{c}	21.79 ±1.03^{ab}	17.34 ±0.76^{ab}	1.61 ±0.17^{b}
T4	60.71 ±1.08^{b}	15.59 ±2.20^{d}	21.64 ±1.66^{a}	1.67 ±0.13^{ab}
T5	61.08 ±0.43^{b}	17.47 ±1.23^{cd}	19.62 ±1.27^{ab}	1.59 ±0.07^{b}
T6	60.52 ±0.88^{b}	16.87 ±2.68^{cd}	20.63 ±2.49^{a}	1.55 ±0.01^{b}

* Treatments are the same as in Table 1.
$^{a-d}$ Means±SD with different superscription in the same column are significantly different($p<0.05$).

Table 3. Effect of replacing pork fat with vegetable oils on quality properties of pork sausages*

Items	pH	WHC(%)**	Cooking loss(%)***	Cholesterol (mg/100g)
T1	6.29 ±0.01[a]	73.15 ±2.70[b]	1.22 ±0.34[a]	46.46 ±7.54[ab]
T2	6.26 ±0.01[b]	74.49 ±3.13[b]	0.57 ±0.07[c]	53.51 ±9.96[a]
T3	6.14 ±0.01[c]	87.18 ±8.34[a]	0.70 ±0.17[bc]	45.15 ±9.42[ab]
T4	6.31 ±0.01[a]	80.27 ±3.12[ab]	0.75 ±0.23[bc]	45.17 ±7.41[ab]
T5	6.16 ±0.03[c]	89.82 ±5.16[a]	1.11 ±0.11[ab]	42.95 ±6.41[ab]
T6	6.14 ±0.01[c]	87.73 ±5.42[a]	0.84 ±0.23[abc]	38.25 ±1.33[b]

* Treatments are the same as in Table 1.
**Water holding capacity
***Consumer cook test weight loss
[a-c] Means±SD with different superscription in the same column are significantly different($p<0.05$).

Table 4. Effect of replacing pork fat with vegetable oils on texture profile analysis of pork sausages*

Items	Hardness (g)	Cohesiveness (%)	Springiness (%)	Chewiness
T1	437.00 ±22.06[a]	42.51 ±8.77[a]	56.04 ±12.38[a]	177.94 ±7.71[a]
T2	426.50 ±39.58[a]	32.49 ±5.31[b]	41.84 ±7.22[c]	65.63 ±10.96[b]
T3	237.00 ±45.65[c]	33.88 ±5.07[b]	42.99 ±8.13[bc]	60.54 ±3.67[b]
T4	305.25 ±25.61[b]	43.16 ±8.93[a]	49.25 ±7.46[ab]	68.08 ±9.96[b]
T5	320.60 ±34.50[b]	33.88 ±7.69[b]	37.70 ±8.56[c]	28.66 ±7.42[c]
T6	197.50 ±6.36[c]	22.91 ±4.14[c]	26.60 ±5.31[d]	18.09 ±1.51[c]

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

IV. CONCLUSION

Vegetable oils may be possibly applied as pork fat substitute in emulsion-type pork sausages since vegetable oils replacement could improve some functional properties of sausages.

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