SOME CHARACTERISTICS OF COLLAGEN AND GELATIN FROM CHICKEN FEET

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Background

Chicken feet is a major edible by-product in poultry slaughterhouse in Asia area and it is usually as a raw material in Chinese delicious menu. But this consumption also is changed now, however, a large amount of chicken feet have been rendered into poultry by- product meal for animal feed. Chicken feet are abundant in collagen and also have been extracted as a medical material for medical usage (Pachence, 1992). Ichie *et al.* (1999) also conducted that a low allergenic gelatin could be produced from chicken cartilage by acid processing. Recently, the consumers had rejected some foods and cosmetics that were prepared from beef collagen or gelatin due to BSE (Bovine Spongiform Encephalopathy) in the whole world. Thus, to seek an abundant source of collagen and gelatin from the other animal species to replace that from beef is the major purpose of this study.

Objective

The objective of this study was to seek the best condition for collagen extraction from chicken feet. Otherwise, the optimum condition and some characteristics of gelatin from chicken feet collagen also were looked for and measured in this research.

Material and Methods

The frozen chicken feet were obtained from a local poultry meat plant in the central area of Taiwan then stored at -20 ℃ for the study. Before grinding chicken feet were thawed at 4 ℃ for 24 hr. The ground chicken feet paste were mixed with 5% of different acid solutions (acetic acid-A, citric acid-C, hydrochloric acid-H and lactic acid-L) and swelled for different times (12, 24, 36 and 48 hours). The pH, swelling percentage, yield, collagen /100g chicken feet from different treatments were determined. In this experiment, collagen powder extracted from soaking in 5% lactic acid for 24 hrs was used as raw material to extract gelatin with different heating temperatures (50, 60, 70 and 80℃) and times (1, 2, 3, 4 and 5 hours). The yield, pH, gel clearness (O.D. 550nm)and rheological properties of gelatin from chicken feet also were determined.

Results and discussion

The chemical composition of chicken feet was demonstrated in Table 1. The swelling percentage of citric acid treatment was significantly increased by soaking time, but the others were not changed (Table 2). The pH value of collagen with all acid treatments was not significantly different with extraction time but collagen from acetic acid had the highest pH among all treatments (Table 3). The collagen yield from acetic acid and lactic acid treatments was significantly higher than that of the other two treatments (Table 4). From Table 4, the highest collagen yield can be found from lactic acid treatment for 24 hr. The collagen of lactic acid 24 hr was used as a raw material for gelatin extraction in this study. The extracted yield of gelatin from 80℃ 2hr was significantly higher than the other treatments (Table 5). The pH value of gelatin from all treatments declined with heating time (Table 6). The gel clearness (550 nm, OD value) of gelatin from all 70℃ treatments had the lowest value among all treatments (Table 7). However, the gelatin from extracted at 60℃ for 4hrs had the best gel property and similar to the commercial product from pig skin.(Table 8).

Conclusion

The optimum condition for collagen from chicken feet is treated by 5% lactic acid for 24hr. Otherwise, all results indicated that an optimum gelatin extracted condition is heated at 60℃ for 4 hr due to the best gel rheological properties.

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Table 1 The chemical composition of chicken feet

Item	Content
Moisture(%)	62.05±0.60
Crude fat(%)	12.04±0.44
Crude protein(%)	17.42±0.73
Collagen(%)	9.07±0.18
Ash(%)	5.98±0.37

Table 2 Swelling percentage of chicken feet by 5% different acids and soaking times

Time (hr)	Acetic acid	Citric acid	HCl	Lactic acid
12	238.55^{ay}	232.50^{by}	134.05^{az}	245.60^{ay}
24	218.80^{ay}	243.35^{abx}	123.65^{az}	239.85^{ay}
36	222.90^{ay}	247.95^{abx}	129.20^{az}	248.65^{ax}
48	230.95^{ay}	264.15^{ax}	132.75^{az}	251.75^{ax}

^{a,b,c}: Means within the same column without the same superscript are significantly different($p<0.05$).
^{x,y,z}: Means within the same row without the same superscript are significantly different($p<0.05$).

Table3 The pH of collagen from chicken feet by 5% Different acids and soaking times

Time (hr)	Acetic acid	Citric acid	HCl	Lactic acid
12	3.44^{bx}	2.43^{cz}	-	2.72^{ay}
24	3.47^{bx}	2.50^{by}	-	2.54^{by}
36	3.62^{ax}	2.63^{ax}	-	2.65^{bx}
48	3.54^{bx}	2.57^{abyz}	-	2.71^{az}

Footnote is the same as Table 2.

Table4 The yield, collagen content (%) and pure collagen g/100g chicken feet of chicken feet by different acids and times

Item	Yield(%)	Collagen (%)	Pure collagen g / 100g chicken feet
Acetic acid			
12hr	31.69^{a}	17.25^{c}	5.46^{c}
24hr	30.86^{a}	17.12^{c}	5.23^{c}
36hr	23.95^{b}	18.00^{c}	4.31^{c}
48hr	31.23^{a}	18.13^{c}	5.66^{c}
Citric acid			
12hr	18.83^{c}	24.91^{b}	4.69^{c}
24hr	13.91^{d}	24.70^{b}	3.44^{d}
36hr	16.00^{c}	24.17^{b}	3.86^{d}
48hr	17.95^{c}	26.72^{ab}	4.80^{c}
Hydrochloric acid			
12 hr	11.66^{d}	12.42^{d}	1.45^{e}
24hr	12.64^{d}	6.24^{e}	0.79^{e}
36hr	8.44^{e}	3.89^{e}	0.32^{f}
48hr	13.82^{d}	6.71^{e}	0.93^{e}
Lactic acid			
12hr	31.48^{a}	25.18^{b}	7.93^{b}
24hr	30.94^{a}	24.51^{b}	7.58^{b}
36hr	30.88^{a}	28.00^{ab}	8.65^{a}
48hr	30.42^{a}	29.54^{a}	8.99^{a}

^{a,b,c,d,e,f}: Means within the same column without the same superscript are significantly different($p<0.05$).

Table 5 The yield (%) of gelatin from chicken feet collagen (lactic acid, 24hr) by different heating times and temperatures

Temp/hr	1	2	3	4	5
50℃	43.12^{ayz}	41.46^{bz}	39.86^{cz}	44.03^{ay}	41.50^{bz}
60℃	42.50^{bz}	44.03^{aby}	41.50^{bz}	43.07^{byz}	46.74^{ax}
70℃	44.14^{az}	45.46^{ayz}	43.85^{bz}	45.36^{ayz}	45.88^{ay}
80℃	45.60^{ayz}	47.63^{ay}	46.03^{ay}	43.94^{az}	45.55^{ayz}

Footnote is the same as Table 2.

Table 6 The pH of gelatin from chicken feet collagen (lactic acid, 24hr) by different heating times and temperatures

Temp/hr	1	2	3	4	5
50℃	5.74^{by}	5.73^{ay}	5.73^{ay}	5.86^{ay}	5.76^{ay}
60℃	5.67^{bx}	5.55^{cy}	5.48^{bz}	5.45^{bz}	5.57^{by}
70℃	5.69^{bx}	5.52^{cy}	5.35^{cz}	5.44^{byz}	5.58^{bx}
80℃	5.97^{ax}	5.65^{by}	5.42^{bcz}	5.38^{cz}	5.55^{by}

Footnote is the same as Table 2.

Table 7 Clearness (550nm OD) of gelatin from chicken feet collagen (lactic acid, 24hr) by different heating times and temperatures

Temp/hr	1	2	3	4	5
50℃	1.426^{ax}	1.046^{bx}	0.910^{cy}	0.968^{bcx}	0.905^{cy}
60℃	1.028^{by}	1.079^{abx}	1.123^{abx}	1.140^{ax}	0.963^{cy}
70℃	0.597^{abz}	0.544^{bz}	0.508^{bcz}	0.416^{cz}	0.633^{az}
80℃	0.798^{abz}	0.734^{by}	0.608^{dz}	0.848^{ay}	0.693^{cz}

Footnote is the same as Table 2.

Table 8 Rheological properties of gelatin from chicken feet collagen(lactic acid, 24hr) by different heating times and temperatures

Temp/hr	1	2	3	4	5
50℃					
Gel strength	39.29^{bx}	27.60^{cz}	27.92^{cz}	43.92^{cw}	30.27^{cy}
Gel breaking strength	64.00^{cx}	50.40^{ez}	57.08^{dy}	85.25^{cw}	67.93^{cx}
Gel jelly	41.50^{bw}	16.90^{dz}	22.58^{cx}	24.08^{cx}	21.60^{cy}
60℃					
Gel strength	73.60^{ay}	75.58^{ax}	55.00^{bz}	98.00^{aw}	88.00^{ax}
Gel breaking strength	166.80^{ay}	164.08^{ay}	124.00^{az}	221.60^{aw}	199.07^{ax}
Gel jelly	68.60^{ax}	50.17^{by}	50.29^{by}	88.00^{aw}	70.57^{ax}
70℃					
Gel strength	28.23^{cy}	21.31^{dz}	28.50^{cy}	27.92^{dy}	26.62^{dy}
Gel breaking strength	57.19^{dz}	70.54^{cw}	64.17^{cwx}	62.85^{dx}	59.85^{dy}
Gel jelly	21.09^{cz}	23.38^{cw}	18.67^{cy}	16.69^{dz}	19.54^{cyz}
80℃					
Gel strength	29.83^{cx}	28.00^{cx}	24.22^{dy}	21.67^{cz}	25.33^{dy}
Gel breaking strength	67.08^{cw}	62.19^{dx}	54.44^{dy}	48.44^{ez}	56.78^{dy}
Gel jelly	20.33^{cx}	14.69^{dz}	11.89^{dz}	13.89^{dz}	18.11^{cy}
Commercial gelatin (pork)					
Gel strength	68.33^{a}	68.33^{b}	68.33^{a}	68.33^{b}	68.33^{b}
Gel breaking strength	111.47^{b}	111.47^{b}	111.47^{b}	111.47^{b}	111.47^{b}
Gel jelly	66.24^{a}	66.24^{a}	66.24^{a}	66.24^{b}	66.24^{ab}

Footnote is the same as Table 2. All data were analyzed by the same item but different temperatures