Indian Journal of Animal Sciences **83** (11): 1215–1218, November 2013/Article

Influence of three starches on properties of salt-soluble protein from Wan-xi White Goose

LIN MEI[1], PENG KONG[2], QINGQING CAO[3] and ZHIGENG WANG[4]

Anhui Agricultural University, Hefei 230 036 China

Received: 22 January 2013; Accepted: 14 May 2013

ABSTRACT

The influence of corn starch, phosphate starch, potato starch on properties of salt-soluble protein from Wan-xi White goose was researched by response surface methodology. Results showed that selected starches all had complex impacts on the properties of Wan -xi white goose salt-soluble protein, and the optimum formula was obtained: corn starch 1.6%, potato starch 1.6%, and phosphate starch 1.8%. The basic characteristics of salt soluble protein target parameter were forecasted as follows: salt soluble protein concentration was 41.3 mg/ml; the amount of active free sulfhydryl was 0.004μmol/mg and the relative hydr-ophobic value was 32.86, the gel water-holding capacity of salt-soluble protein was 40.6%.

Key words: Active free Sulphydryl, Relative hydrophobic value, Salt-soluble protein, Starch, Wan-xi White goose

Herreroa *et al.* (2008) indicated that increase in hardness and chewiness was observed due to soy-protein isolate (SPI) addition in heated meat sample. Comfort and Howell (2002) reported that a less brittle and smoother texture was observed with the low soluble wheat proteins (SWP) concentration, when meat protein was replaced by SWP. The goose has become the world's second largest meat consumption goods. Wan-xi white goose is an important medium-sized goose which is put into national livestock and poultry genetic resources protection list in China. The meat is famous for their rich flavor substance, essential amino acid and low fat. The study about Wan-xi white goose is also limited. This study was made to determine the influence of 3 kinds of starches (corn starch, potato starch and phosphate starch) on the wan-xi white goose salt soluble protein processing property, to provide technical basis for application of starch in goose processing.

MATERIALS AND METHODS

Wan-xi white gooses were obtained commercially. Muscles samples were trimmed of visible fat and connective tissues, cut into cubes (10 cm ×10 cm ×5cm), smashed by tissue crushing stamp mill at maximum speed for 60s, and preserved by 2.5% NaCl (0 ~ 4 !, 1 ~ 2h). Salt-soluble proteins (SSP) were extracted from goose breast and thigh according to Chen *et al.* (2007). Gel was prepared according to Jingxin Sun *et al.* (2012). Ellman assay was adopted and made certain improvements to determine the activity of free thiol. Take 1ml salt-soluble protein solution into 5ml 5 - mercapto -2-nitrobenzoic acid (DTNB) analytical solution (0.1mol / litre)l pre-heated at 25 ! water bath, shake it up, accurately standing for 10 min, absorbance values measured at 412nm immediately. If the absorbance was too large, use 0.25mol / l of Tris-HCl solution (pH = 8.3) to dilute it.

ANS-Na fluorescence probe was adopted to determinate the hydrophobicity. Heat-induced gel was centrifuged at×1000 g for 3 min at room temperature. The WHC was expressed as a percentage of the present sediment content of the gel. Selected the corn starch, potato starch and phosphate starch, then mixed the starches with wan-xi white gooses-meat separately for different proportions (0, 1, 2, 3, 5, 8, 12, 15, 20%) to make the meat emulsion respectively.

On the basis of the result of single factor test, taking

Table1. Three-factor quadratic universal rotator experiment design

	Corn Starch	Potato Starch	Phosphate Starch
+∫	5%	5%	5%
+1	3.51%	3.51%	3.51%
0	2.5%	2.5%	2.5%
-1	1.01%	1.01%	1.01%
-∫	0%	0%	0%

X_1, corn starch; X_2, potato starch; X_3, phosphate starch.

Present address: [1]Lecturer (meilin8880@sina.com.cn), [2]Master (kp1986@126.com), [3]Master (yimi_qingqing@yahoo.com.cn), [4]Professor (wzhg56@yahoo.com.cn), College of Tea and Food Science and Technology.

precipitate protein concentration, thermally induced water retention gel, amount of free thiol and hydrophobic as targets, controlling total addition of starch in 5%,determinated the influence on of starches on goose meat further (Table 1). All data were analyzed using SAS 9.1.

RESULTS AND DISCUSSION

Effect of single starch: Corn starch, potato starch and phosphate starch (on the concentration of salt-soluble protein precipitation, the water holding capacity of heat induced gel retention, the active free hydrosulphonyl and the hydrophobicity of wan-xi white goose) showed that curved shapes of influence of the 3 starches on concentration of salt-soluble protein precipitation, water-holding capacity of heat induced gel retention, active free hydrosulphonyl and the hydrophobicity of wan-xi white goose were all like parabola (Fig.1a-d). The effects of the 3 kinds of starch on salt soluble protein precipitated concentration were of little difference. Wherein, corn starch and phosphate starch is better than potato starch, which may be attributed to the physicochemical differences between starches.

The relationship between amount of starch added and total amount of active free sulfhydryl of goose salt soluble protein was complex, wherein, changing trends of potato starch and phosphate starch were basically the same, Fig. 1(c). When the added amount was not more than 12%, both phosphate starch and corn starch could significantly improve amount of free active sulfhydryl in mixed gel system. Although the added starch suppressed degradation of free active sulfhydryl of salt soluble protein, and it was sure that changed content of sulfhydryl was bound to change spatial structure of salt soluble protein (Chan and Gill, 1995).

Fig. 1(d) showed that addition of starch, increased hydrophobic property of salt soluble protein first and then declined. Decline of potato starch was relatively stable, while rising and decline of corn starch were more rapid. When 0%~2% starch was added, the relative hydrophobic property of goose salt soluble protein increased. It was probably because that starch destroys mutual hydrophobic effect when gelatinized, which generates and exposes more hydrophobic regions, resulting in increase of relative protein hydrophobic value. When starch was added over 2%, a sufficient amount of gelatinized starch was embedded by mesh structure and property of hydrophobic group was modified, resulting in decrease of relative hydrophobic value.

Interaction influence of three starches on precipitation, water holding capacity of heat induced gel retention, active free hydrosulphonyl and hydrophobicity of salt-soluble protein: With corn starch, potato starch and phosphate starch respectively as three factors of X_1, X_2 and X_3 for five-level

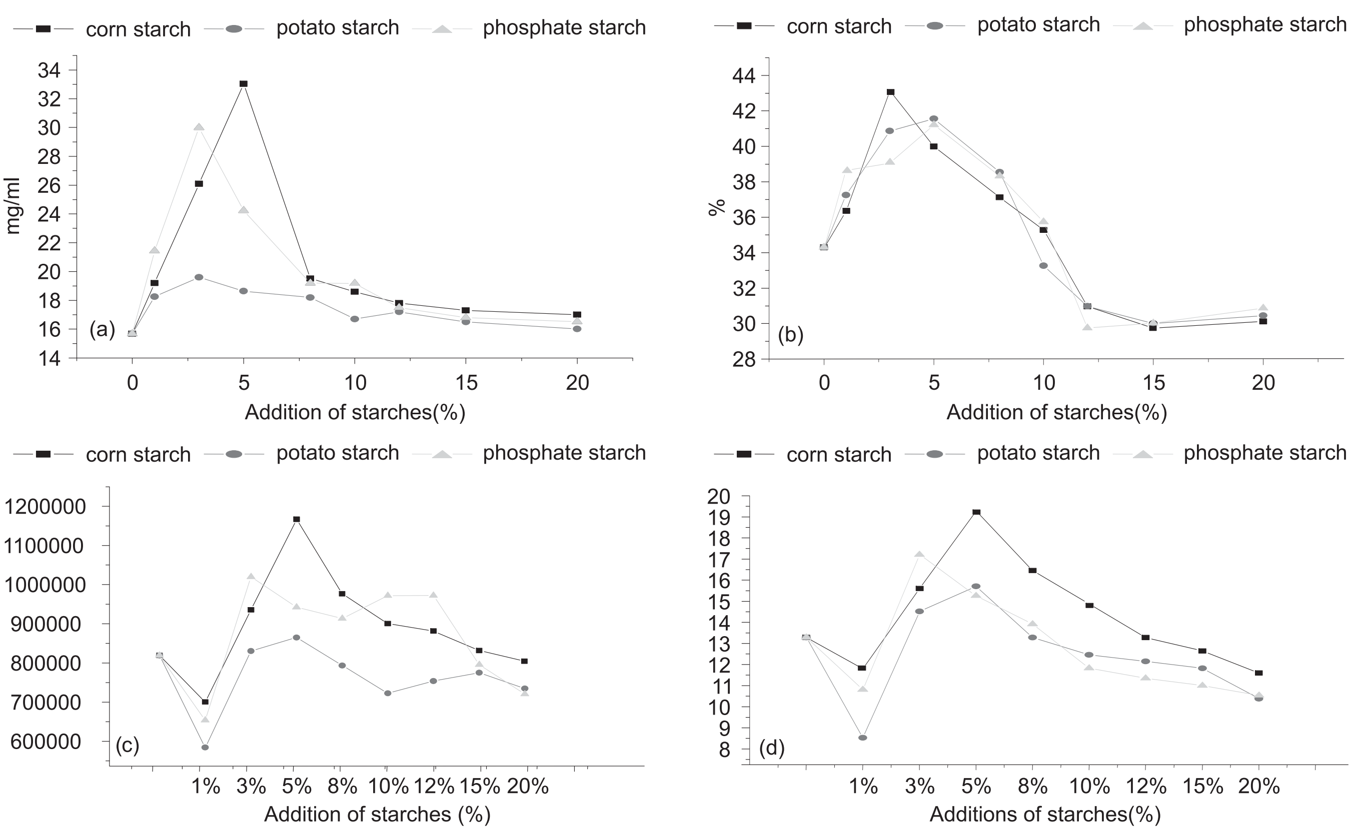

Fig. 1. Influence of single starch on concentration of salt-soluble protein (a); water-holding capacity (b); value of reactive sulfhydryl group(c); and relative quantity of hydrophobic nature (d) from wan-xi white goose

rotation orthogonal test and taking concentration of salt-soluble protein (a), water holding capacity (b), value of reactive sulfhydryl group(c), and relative quantity of hydrophobic nature (d) as the indicator respectively, regressions model was carried out on the test results with a regression analysis. Excluding insignificant items with significance test through SAS9.1 the regression model equations after simplified were as follows:

$$Y=15.882+83.315x_1+122.9x_3-90.47x_1^2-47.02x_2^2-159.29x_3^2-178.41x_1x_3\ (R^2=0.8757) \tag{A}$$

$$Y=-0.03+1.544x_1+1.159x_2+1.664x_3-2.59x_1^2-2.23x_2^2-2.52807x_3^2-1.47x_1x_3(R^2=0.9332) \tag{B}$$

$$Y=0.00272+0.0321x_1+0.03548x_3-0.02513x_1^2-0.01817x_2^2-0.0371x_3^2-0.0734x_1x_3(R^2=0.8043) \tag{C}$$

$$Y=-32.933+224.002X_1+123.18X_2+254.85X_3-264.97X_1^2-278.13X_2^2-373.69X_3^2-341.16X_1X_2(R^2=8360) \tag{D}$$

By equation (A), we could found that 3 factors of the test were all the main factors that affect concentration of salt soluble protein precipitation. By (B), it could be seen that interaction of corn starch and phosphate starch on water-holding capacity was significant. By (C), we found that 3 factors of the test were main factors that affect total free sulfhydryl of salt soluble protein precipitation. And, by (D), the three factors of the test were the main factors that affect thydrophobicity of salt-soluble protein.

The equations (A, B, C, D) were analyzed by dimensionality reduction and interactive effects of equations (a, b, c, d) were got:

$$Y=15.882+83.315x_1+122.9x_3-90.47x_1^2-159.29x_3^2-178.41x_1x_3 \tag{a}$$

$$Y=-0.03+1.544x_1+1.664x_3-2.59x_1^2-2.52807x_3^2-1.47x_1x_3 \tag{b}$$

$$Y=0.00272+0.0321x_1+0.03548x_3-0.02513x_1^2-0.0371x_3^2-0.0734x_1x_3 \tag{c}$$

$$Y=-32.933+123.18X_2+254.85X_3-278.13X_2^2-373.69X_3^2 \tag{d}$$

Determination of compound starches formulation: By results of test, when starch was not more than 5%, and proportions of three kinds of starch were: 1.6% of corn starch, 1.6% of potato starch and 1.8% of phosphate starch, 4 indicators, including salt soluble protein precipitated concentration, salt soluble protein heat-induced gel water-holding rate, total amount of free sulfhydryl and hydrophobic property, achieved better values and salt soluble protein concentration was 24.3 mg/ml; salt soluble protein heat-induced gel water-holding rate was 43.12%; amount of active

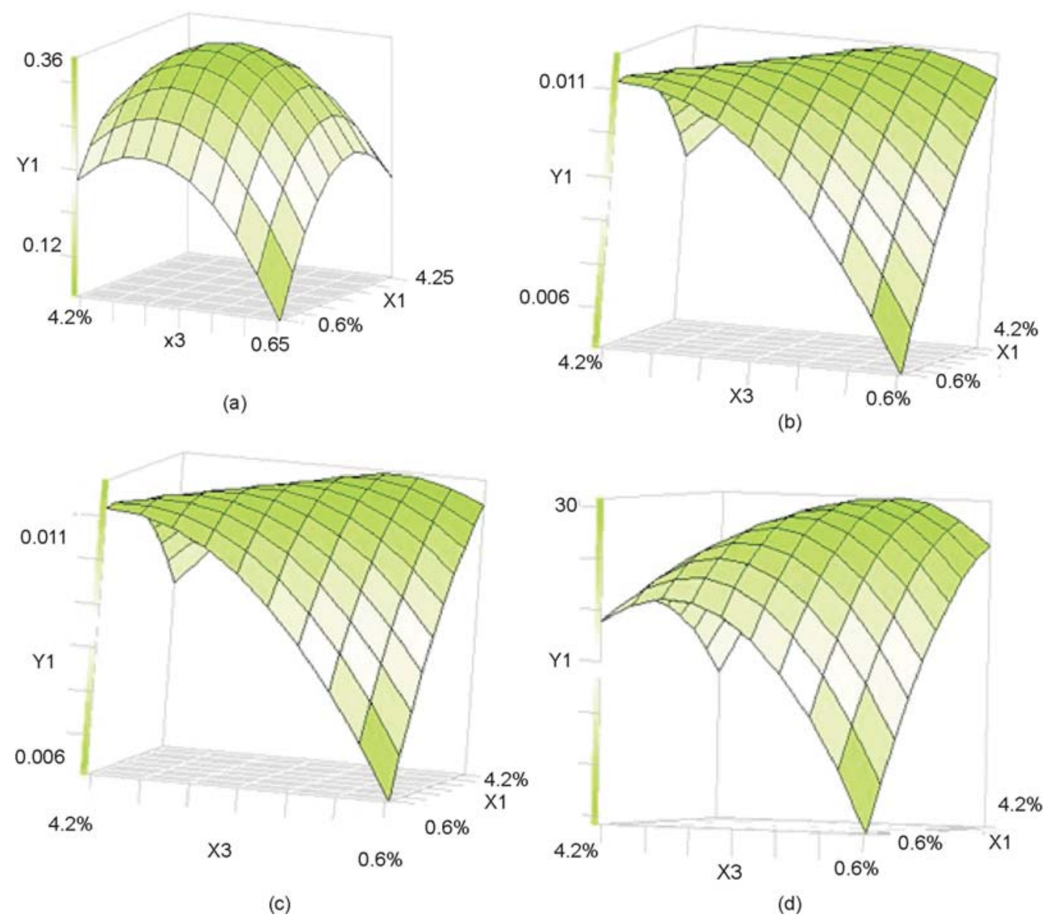

Fig. 2. Response surfaces of starches on salt soluble protein precipitation concentration (a), water holding capacity (b), value of reactive sulfhydryl group(c), and relative quantity of hydrophobic nature (d) from wan-xi goose.

free sulfhydryl was 0.004μmol/mg and relative hydrophobic value was 33.86. Experimental verification was carried out in accordance with this ratio. The test result was that salt soluble protein concentration was 24.21mg/ml; salt soluble protein heat-induced gel water-holding rate was 42.77%; amount of active free sulfhydryl was 0.041μmol/mgμmol/mg and relative hydrophobic value was 22.86. The errors were less than 5%, proving that the design of compound starch formula was successful.

The conclusions drawn were: (*i*) corn starch, potato starch and phosphate starch all had effect on the salt soluble protein, precipitation concentration, and heat induced gelation and spatial structure of the goose meat, but for different indicators, the three starches were inconsistent; (*ii*) 3 starches had significant interaction effects on salt soluble protein precipitated concentration. Potato starch and phosphate starch have significant interaction effects on salt soluble protein heat-induced gel water-holding rate. Corn starch and potato starch as well as corn starch and phosphate starch have significant interaction effects on total amount of free sulfhydryl of salt soluble protein, while 3 kinds of starch have insignificant interaction effects on hydrophobic property of salt soluble protein. (*iii*) With total content of starch not more than 5%, optimal formula of three kinds of starch was 1.6% of corn starch, 1.6% of potato starch and 1.8% of phosphate starch. At the moment, salt soluble protein concentration was 41.3mg/ml; amount of active free sulfhydryl was 0.004μmol/mg and relative hydrophobic value was 32.86, gel water-holding capacity of salt-soluble protein was 40.6%which facilitates minced goose meat product to have a better processing quality.

REFERENCES

Chan H K and Gill T A. 1995. Herring during low temperature setting. *Food Science* **60**: 1248–53.

Chen H H, Xu S Y and Wang Z. 2007. Interaction between axseed gum and meat protein. *Journal of Food Engineering* **80**: 1051–59.

Comfort S and Howell K N. 2002. Gelation properties of salt soluble meat protein and soluble wheat protein mixtures. *Food Hydrocolloids* **17**:149–59.

Herreroa A M, Carmonab P and Cofradesc S. 2008. Raman spectroscopic determination of structural changes in meat batters upon soy-protein addition and heat treatment. *Food Research International* **41**(7): 765–72.

Hongsprabhas P and Barbut S. 1999. Effect of pre-heated whey protein level and salt on texture development of poultry meat batters. *Food Research International* **32**(2):145–49.