S7P06.WP

THE STUDY OF CHICKEN MEAT-MASH SAUSAGE PRODUCT

IN CHEN, ZHANG GEN SHENG, MIN LIAN JI, YU LI JUAN, and LI JIAN

Hei Long Jiang Commercial College Harbin 150076 CHINA

INTRODUCTION

With the development of the poultry industry in our country together with an increase in the export of chicken, the amount of refined chicken is dramatically increasing. As such, many factories have faced a problem, which is the difficulty of dealing with the chicken by-products. Although the skeletons produce a waste disposal problem they must be abandoned since there are no effective means of utilizing them. According to "non-total" 1990 statistics, the Chinese foul stock amounted to about 2.2 million birds, which could produce 500,000 tons of skeleton. Furthermore, the edible portion of this waste equalled more than about 370,000 tons.

In countries such as China where the people's daily protein intake is inadequate, meat researchers must be concerned with the efficient utilization of these resources. Until the present there have been two suitable ways to accomplish this. One is to process the chicken skeleton into a meat-bone-mash. This method causes the flesh to sustain serious damage in the grinding process, making it unsuitable for sausage production. It's poor emulsification quality and high minced bone content are the principle reasons for this.

The other method of processing is to separate the minced meat and marrow from the bone using a bone-cleaner. Thus, we can obtain a type of chicken meat-mash, the main content of which is minced meat and marrow, which could be used as a new food resource. The purpose of the experiment reported in this paper was to develop applications for this new protein resource in various sausage forms having low price and high quality. The comparative method and the orthogonal analysis method were adopted in order to develop the necessary sausage formula and technological process for making it. The ultimate goal of this work has been to increase the variety of available meat products, enrich the meat-products market, and enhance the economic performance of the poultry industry.

MATERIAL AND METHODS

The sausages used in this study were manufactured from the following ingredients: pork, animal casing, potato starch, smoke flavouring, fragmented chicken meat and chicken meat-mash. All of the ingredients were purchased with the exception of the fragmented chicken meat and chicken meat-mash, which were prepared at the Hei Long Jiang Agricultural Machinery Institute.

The sausages were prepared by the following processing steps:

1. Combine ingredients in correct proportions
2. Add salt
3. Chop
4. Blend and thoroughly mix ingredients
5. Insert sausage meat in casings
6. Dry the sausage links
7. Boil
8. Smoke

Materials were either weighed on a balance (Type HCTP12B-1, Beijing Medical Scale Factory) or a scale (Type AGT-

10). The meat mixture was chopped with a chopping machine (Type CPX-12, Harbin Commercial Mechanical Factory), and a filling machine (Type DJ-12) was used to fill the casings.

A standard method of sensory evaluation was developed and applied using a 7-10 member experienced taste panel. The criteria and evaluation scheme that was used by the panel is given in Table 2.

The orthogonal test method was used to determine the optimum combination of the main ingredients, these being starch, chicken meat-mash, lean meat, and pork fat. The test proportions of these ingredients are given in Table 3, which represents an $L_8(3)^4$ orthogonal chart.

RESULTS AND DISCUSSION

On the basis of the orthogonal design levels given in Table 3, nine formulations were developed, as given in Table 4.

To account for losses and experimental error, a formula was developed to estimate the actual material weight in the finished sausage product based on the raw sausage weight, the raw material weight, and the weight of material used at the filling stage (immediately after blending). This formula is given as follows:

$$G_1 = (G_2/G_3)\, G_0$$

Where: G_1 = the estimated actual material weight (g)
G_2 = the raw sausage weight (g)
G_3 = the fill weight after blending (g)
G_0 = the raw material weight (g)

The closeness of the estimated actual final product weight to the measured end product weight was defined by the following percentage, referred to as the "end product yield"

$$Y = 100 \times G_w/G_1$$

Where: Y = end product yield (%)
G_w = end product weight (g)

The material weights (G_0, G_1, G_2, G_3, G_w) for each of the nine experimental sausage formulations are given in Table 5, together with the end product yield percentage values.

Results of the sensory evaluations are presented in Table 6. According to the results presented in Table 5, an orthogonal analysis was conducted. The results of this analysis are given in Table 7.

From the data presented in Table 7, we can conclude that the factors which affect the end product yield of chicken meat-mash sausage are, in order of importance, A (starch), C (lean meat), B (chicken meat-mash), and D (pork fat). Furthermore, on the basis of end product yield, the optimum sausage formulation was found to be $A_2B_2C_3D_1$.

According to the results presented in Table 5, an orthogonal analysis of the sensory properties of the chicken meat-mash sausages was also conducted. The results of this analysis are presented in Table 8.

According to the data presented in Table 8, it was concluded that the factors which affect the sensory properties of sausages, in order of importance, are: A (starch), B (chicken meat-mash), C (lean meat), D (fat meat). On the basis of sensory quality, the optimum sausage formulation was found to be $A_3B_1C_1D_1$.

Since different sausage formulations were determined to be optimum on the basis of end product yield and sensory quality, respectively, a single "best" overall formulation was determined using the following arguments. The "A_2" (starch) factor level was selected on the basis that the sensory qualities were not significantly affected by the starch level difference between A_2 and A_3. The "B_1" (chicken-meat-mash) level was selected on the basis of the importance the chicken-meat-mash content had on the sensory properties of the sausage. The "C_3" (lean meat) level was selected on the basis that the lean meat content is highly important with respect to its influence on the end product yield, although a "C_1" level might have been preferable from the sensory quality perspective. Finally, the "D_1" (pork fat) level was selected on the basis of both quality and yield. Thus, the best formulation was determined to be $A_2B_1C_3D_1$ which can be expressed in percentage terms unadjusted, together with the other ingredients, as follows:

Ingredient	Percentage by weight
chicken-meat-mash	50
lean pork meat	40
pork fat	10
starch	10
water	10
smoke flavouring	0.2
sodium glutamate	0.2
pepper	0.3
monascorubin	0.1
onion	0.5
ginger	0.5
garlic	1.0

CONCLUSIONS

It is feasible to replace comminuted pork with chicken-meat-mash for the purposes of producing a pork-chicken meat sausage. This application of chicken meat processing residue provides a means of utilizing an otherwise wasted protein resource, lowers the cost of producing sausages, and also increases the nutritional content of the calcium and phosphate components in the product.

This means of utilizing chicken-meat-mash therefore helps to solve the growing problem of protein insufficiency in the Chinese diet. Finally, the orthogonal analysis of the experimental data obtained in this study was instrumental in determining an overall optimum formula for chicken-meat-mash sausages having proportions of lean meat/pork fat/chicken-meat-mash/starch of 40/10/50/10.

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Table 1. Nutrition ingredient analysis of chicken meat-mash.

Ingredient	Content
Crude protein	12.63%
Crude fat	20.47%
Moisture	63.63%
Calcium	0.60%
Phosphate	0.32%

Table 2. Chicken meat-mash sensory evaluation.

Score / Criteria	8 - 10	4 - 7	1 - 3
Colour	regular attractive	normal; acceptable	bad; inedible
Elasticity	good	normal	bad
Sliver-ability	smoothy; glossy; cut noddles; not sticky	a little glossy; not sticky	not smooth; not glossy
Taste	delicious; not greasy; no after taste	a little greasy; not a rare delicious taste	greasy; rare delicacy

Table 3. Chart title design of orthogonal test.

Factor level	(A) (%) Starch	(B) (%) Chicken Meat-Mash	(C) (%) Lean Meat	(D) (%) Pork Fat
1	5	25	60	5
2	10	50	40	10
3	15	75	20	15

Table 4. Ingredient chart of orthogonal test for chicken meat-mash sausage.

Times Ingred.	1	2	3	4	5	6	7	8	9
starch, %	70	80	70	140	155	145	206	174	140
Chicken meat-mash, g	350	800	1050	500	1000	750	625	550	750
Lean meat, g	840	640	280	800	400	600	500	450	600
Pork fat, g	210	160	70	100	150	100	250	165	50
monas-corbin, g	1.4	1.6	1.4	1.4	1.6	1.4	1.4	1.17	1.4
garlic, g	14	16	14	14	16	14	14	12	14
ginger, g	7	8	7	7	8	7	7	6	7
onion, g	7	8	7	7	8	7	7	6	7
sodium gluta-mate, g	2.8	3.2	2.8	2.8	3.2	2.8	2.8	2.3	2.8
pepper, g	2.8	3.2	2.8	2.8	3.2	2.8	2.8	2.3	2.8
smoke flavourg	2.8	3.2	2.8	2.8	3.2	2.8	2.8	2.3	2.8
water, g	250	184	167	235	236	210	270	215	210

Table 5. Chicken meat-mash sausage product weights and end-product yields.

#:	1	2	3	4	5	6	7	8	9
G3	1425	1590	1515	1615	2385	1540	1875	1510	1510
G0	1325	1380	1295	1250	1605	1355	1461	1274	1230
G2	1395	1500	1490	1520	1785	1395	1880	1470	1480
G1	1297	1345	1274	1176	1201	1227	1442	1240	1205
Gw	1210	1325	1300	1405	1645	1255	1720	1374	1365
Y	93.3	98.5	102	119.5	136.9	102.3	119.3	110.8	113.2

where: G3 = blended material, weight (g)
G0 = raw mechanical, weight (g)
G2 = raw sausage, weight (g)
G1 = actual material, weight (g)
Gw = end-product, weight (g)
Y = end-product, yield (%)

Table 6. Sensory evaluation results for the experimental chicken meat-mash sausages.

Sausage Code	Score
1	7.5
2	5.5
3	4.5
4	7.5
5	5.0
6	7.5
7	6.0
8	6.5
9	7.5

Table 7. Orthogonal analysis results for the experimental chicken meat-mash sausages.

Item	Starch (A)	Chicken meat-mash (B)	Lean meat (C)	Pork fat (D)
K1	293.8	332.1	306.4	341
K2	358.7	346.2	331.2	320.1
K3	343.7	317.5	358.2	332.3
k1	97.9	110.7	102.1	113.7
k2	119.5	115.4	110.4	106.7
k3	114.4	105.8	119.4	110.8
r	21.6	9.6	17.3	7

Table 8. Orthogonal analysis results for sensory evaluation data.

Factor	Starch (A)	Chicken meat-mash (B)	Lean meat (C)	Pork fat (D)
K1	17.5	21.0	21.5	20.5
K2	20.0	17.0	19.0	19.0
K3	20.5	20.0	15.5	18.5
k1	5.83	7.0	7.2	6.83
k2	6.67	5.67	6.33	6.33
k3	6.83	6.67	5.17	6.17
r	1.0	1.73	2.03	0.66