Pak. j. sci. ind. res., vol. 33, no. 7, July 199

PROTEIN CONCENTRATES FROM POULTRY BY-PRODUCTS
Part II. Intestines, Legs, Skin, Skin-Cum Feathers

A. Haque Hafiz, M. Afzal Malik and Islam Chaudhry
PCSIR Laboratories Complex, Lahore-54600, Pakistan

(Received January 19, 1989; revised July 24, 1990)

Protein concentrates produced by autoclaving separately poultry intestines, legs, skin or skin-cum-feathers contained 68.25, 60.00, 58.70 and 70.10% protein respectively alongwith a considerable amount of fat, Ca and P. Enzyme digestibilities of the respective protein concentrates were 70.00, 73.00, 86.00 and 82.00%. Additionally, protein concentrates from skin- cum-feathers were prepared also on semi-pilot plant scale.

Key words : Poultry by-products, Protein concentrates, Digestibility and autoclaving.

Introduction

Attempts have been made by various workers to isolate protein concentrates (PC) by subjecting poultry by-products to steam under pressure [1-4] or by treating poultry wastes enzymatically [5-9]. Most of the work conducted for the production of protein concentrates from poultry wastes is in the form of patents, thus the technology is not available for local feed processors. The protein concentrate (PC) produced can be used as a source of animal protein in feed.

Poultry wastes are abundantly available in the main cities of Pakistan and can be utilized for the production of PC. The objective of the study is to improve the nutritional characteristics of the poultry by-products (particularly keratinous protein) by making them more available to the digestive enzymes of animal systems, thus enhancing their economic value and utilization.

Materials and Methods

Poultry by-products are collected manually from the shops of butchers. All the poultry wastes, except intestines (from which excrements are first removed and then washed), are as such steamed under pressure. Skin-cum-feathers poultry by-product is as such available; the approximate ratio of skin to feathers is 7:9. In the light of previous work the protein concentrate (PC) were prepared from poultry by-products by the following method:-

Steaming under pressure. The poultry by-products (intestines, legs, skin or skin-cum-feathers) were weighed separately; placed in a metallic container and covered with water. The by-products were autoclaved at 120° and the atmospheric pressure of 15 lbs. psi for 60 min. (or 30 min. in case of skin).

After autoclaving the surface fat was skimmed, the water was decanted off and the protein concentrate (PC) obtained was rinsed with hot water, pressed manually to remove fat particles, drained, dried in a hot air-oven at 70-75°, ground, sieved, weighed and preserved in plastic bags. The process was replicated three times.

Semi-pilot plant scale production of protein concentrate (PC) from skin-cum feathers poultry wastes. The parameters for semi-pilot plant scale production of protein concentrate (PC) from skin-cum-feathers were established in the light of the laboratory experiments conducted successfully. However, here, besides the residue (PC-I), the supernatant was further processed as depicted in Fig.1 to obtain PC-II.

Proximate analysis of the protein concentrate. The moisture content of the PC was determined by drying in an oven at 105° for 6 hr [10]. Nitrogen was estimated by Markham micro-method (II) and the nitrogen value obtained was multiplied with 6.25 to get protein value of the sample [12]. The fat content was determined in dried sample extracted with petroleum-either, in soxhlet apparatus [13]. Crude fibre was determined by an acid and alkali digestion method [14]. The ash content of the PC was obtained by ashing the sample in a muffled furnace at 550-560° [15]. Phosphorous was determined in an acid digested sample using colourimetric technique [16]. A volumetric method using a standard solution of ETDA and Cal red as an indicator was used to determine calcium content of a pre-ashed sample dissolved in HCl [17]. The analysis of each sample was conducted in duplicate.

The enzyme digestibility of the PC was determined with pepsin solution in HCl (pH 1.5) by AOAC method [18].

Results and Discussion

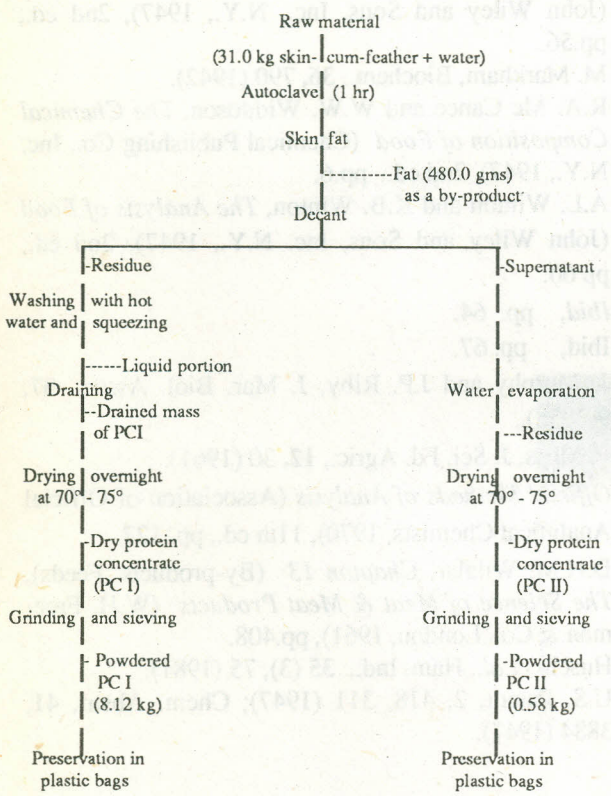
(A) Percentage yield of protein concentrate (PC) from poultry intestines, skin, skin-cum-feathers and legs is 11.37, 10.90, 26.47 and 27.50 respectively (Table 1).

The percentage of moisture content in PC prepared from poultry legs is the lowest (5.90) and that of skin is the highest, 8.10 (Table 1). Wilder [19] has reported 8.5% moisture content in poultry by-product meal.

Protein content of the PC produced from poultry skin, legs, intestines or skin-cum-feathers is 58.46, 60.00, 68.16 and 70.08% respectively (Table-1). In a previous study, carried out in these Laboratories, the protein value obtained

for the PC, prepared by autoclaving poultry feathers, was 82.30%. Hussein et. al. [20] have reported 74.20% protein content of the meat-bone meal prepared from chicken waste. In the present study the protein value (58.46%) of the PC obtained from poultry skin is comparatively low; nevertheless, it is a little more than the protein value (56.40%) reported in literature [19] for poultry by-product meal.

Percentage fat content of the PC prepared from poultry legs, intestines, skins or skin-cum-feathers is 13.06, 14.76, 21.4 and 14.96 respectively (Table 1). As reported in literature [2, 19, 21] fat content of PC/poultry by-products meal varies from 16.40 to 39.75% according to the raw material used and technique applied for proceeding it.



(Each result is the average of two observations)

Fig.1. Semi-pilot plant scale production of protein concentrates from skin-cum-feathers poultry wastes.

Crude fibre content is in trace (Table-1) in each of the four samples of PC prepared. According to Trtik [2] the meals prepared from bones and feathers (1 : 4) and from other (than bones) poultry wastes and feathers were found low in fibre.

A notable amount of ash is present in the samples of PC produced from poultry by-products (Table 1), being maximum (12.96%) in case of PC obtained from legs; these results correspond to the results (14.6% ash) reported by wilder [19] in poultry by-product meal. A high amount 627 mg and 143 mg respectively of Ca and P is present per 100 g of PC produced from poultry legs (Table 1).

Pepsin digestibility of the PC prepared from intestines, skin or skin-cum-feathers is 84.10, 86.03 and 82.0% respectively which values correspond to the value (83.3%) obtained by Wilder [19] for poultry by-product meal.

(B) 8.12 kg. of PC-I were produced when 31.0 kg. of skin-cum- feathers poultry wastes were autoclaved for 1 hr. Before the separation of PC-I, fat (480.0 g) on the surface of the liquid was skimmed as a by-product. Water from the supernatant was evaporated to get PC-II which was dried over night at 70.75°. The dry PC-II was ground, sieved, weighed 0.58 kg (Fig. 1), and it was then packed in a plastic bag.

Proximate analysis of PC-I and PC-II prepared from skin-cum- feathers poultry waste on semi pilot plant scale (Fig. 1) is shown in Table 2. Percentage yields of PC-I and percentage of moisture, fat, fibre, ash, protein and pepsin digestibility, all these values, correspond to the respective values shown in Table 1 (when the PC was prepared on laboratory scale). Percentage yield of PC-II obtained from supernatant (Fig. 1) is only 1.87% (Table 2); the protein and fat value (72.80 and 17.10% respectively) are, in this case little more than those of PC-I. Similarly, ash Ca and P contents are comparatively a little more in PC-II than in PC-I (Table-2). Pepsin digestibility in case of PC-II (78.0%) in about 3.0% less than that obtained (82.0%) for PC-I (Table 2).

The protein concentrate produced by autoclaving poultry wastes (intestines, legs, skin or skin-cum-feathers) is expected to be used safely as a substitute for alternative animal protein in poultry feed. This assertion of these authors is corroborated by the fact that Akkilic [4] prepared

TABLE 1. PROXIMATE ANALYSIS AND ENZYME DIGESTIBILITY OF PROTEIN CONCENTRATE (PC) PRODUCED BY AUTOCLAVING POULTRY BY-PRODUCTS.

Poultry by-product	PC (% yield)	Moisture %	Protein %	Fat %	Fibre %	Ash %	Ca % (mg/100 g)	P % (mg/100 g)	Pepsi digestibility
Intestines	11.37	7.26	68.16	14.76	Traces	6.03	193	57	84.16
Legs	27.50	5.90	60.00	13.06	Traces	12.96	627	140	72.96
Skin	16.90	8.10	58.46	21.46	Traces	5.46	180	59	86.03
Skin-cum-feather	26.47	6.46	70.06	14.96	Traces	5.89	141	43	82.00

Each result is the average of three observations.

TABLE 2. PROXIMATE ANALYSIS AND ENZYME DIGESTIBILITY OF PROTEIN CONCENTRATES (PC) PREPARED ON SEMI-PLANT SCALE BY AUTOCLAVING SKIN-CUM-FEATHERS.

Protein concentrates	PC (% yield)	Moisture %	Protein %	Fat %	Fibre %	Ash %	Ca (mg/100 g) %	P (mg/100 g)%	Pepsin digestibility%
PC I	26.01	6.55	70.21	14.90	Traces	5.69	139	42	82.01
PC II	1.87	6.30	72.82	17.11	Traces	7.18	151	49	78.90

Each result is the average of two observations.

by-products meal by processing different poultry by-products under steam pressure, and observed that when fish meal in the ration of chicks was substituted by the meal (upto 12% of the ration) there was no detrimental effect on the chick growth.

Acknowledgement. The authors are grateful to Dr. Mirza Arshad Ali Beg, Director, PCSIR Laboratories, Lahore for his helpful discussions and valuable suggestions during this investigation. The authors thank Dr. A.F.M. Ehteshamuddin, Chief Scientific Officer for his encouragement during this study and for providing facilities for semi-pilot plant scale production of the protein concentrates. The authors also thank Mr. M. Aslam Khan, Senior Technician and Mr. Javedul Haq, Attendant, for their assistance.

References

1. J.P. Cherry, C.T. Young and A.L. Sheufelt, J. Fd. Sci., **40** (2), 331 (1975).
2. M. Trtik, Krmivastvi Sluzby (Czecb.), **13** (3), 58 (1977).
3. Japan Patent, 84, 141, 593 (1984); Chem. Abstr., **102,** 111904 (1985).
4. M. Akkilic, Ankara Univ. Vet. Fak. Derg. (Turkish), **24** (1), 1 (1977).
5. J. Velicky et.al., Vet. Casopia (Czech.), **11,** 392 (1962).
6. German Patent, 1962, 208 (1970); Chem. Abstr., **73,** 75981 (1970).
7. Ziecik, Morian *et.al.,* Dev. Fd. Sci., **9,** 401 (1964).
8. F. Morislaw and S. Krzystof, J. Sci. Fd. Agric., **37** (5), 445 (1986).
9. German Patent, 3, 539, 231 (1987), Chem. Abstr., **107,** 95636 (1987).
10. A.L. Winton and K.B. Winton, *The Analysis of Food,* (John Wiley and Sons, Inc., N.Y., 1947), 2nd ed., pp.56.
11. M. Markham, Biochem., **36,** 790 (1942).
12. R.A. Mc Cance and W.W. Widdoson, *The Chemical Composition of Food* (Chemical Publishing Co., Inc. N.Y., 1947), 2nd ed., pp.6.
13. A.L. Winton and K.B. Winton, *The Analysis of Food* (John Wiley and Sons, Inc. N.Y., 1947), 2nd ed., pp 60.
14. *Ibid,* pp. 64.
15. Ibid, pp. 67.
16. J. Murphy and J.P. Riby, J. Mar. Biol. Assoc., **37,** 9(1958).
17. P. Moss, J. Sci. Fd. Agric., **12,** 30 (1961).
18. *Official Methods of Analysis* (Association of Official Analytical Chemists, 1970), 11th ed., pp. 127.
19. D.H.M. Wilalar, *Chapton 13* (By-products, Feeds), *The Science of Meat & Meat Products* (W.H. Freeman & Co., London, 1961), pp.408.
20. Huscin *et.al.*, Ham. Ind., **35** (3), 75 (1981).
21. U.S. Patent, 2, 418, 311 (1947); Chem. Abstr., **41,** 3884 (1947).