

NUTRITIONAL AND PHYSICO-CHEMICAL QUALITY EVALUATION OF POULTRY AND DAIRY INDUSTRY BY-PRODUCTS

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SUMMARY

Under the present study the nutritional and physico-chemical quality of different poultry and dairy industry by-products such as chicken skin, chicken liver and gizzard powder, hatchery waste and ghee residue was evaluated to explore the potential for the inclusion in the pet foods. Chicken liver powder have 60% crude protein, 18% ether extract, 0.6% crude fibre and 7.52 % total ash. Chicken gizzard powder is having 58.6% crude protein, 17.45% ether extract, 0.75% crude fibre and 7.44% total ash. Hatchery waste was analyzed for its proximate composition and was found having 22.73% crude protein, 4.06% ether extract, 10.8% crude fibre and 23.6% total ash. Among dairy industry by-products, ghee residue has 25.37% crude protein, 43% ether extract and crude fibre 0.4%. Free fatty acid content of all samples was less than the critical limits ranging from 0.46 to 1.11 % which indicate that ingredient were of good quality. Peroxide value of ghee residue, liver powder, gizzard powder and hatchery waste was 2, 2, 4 and 6 (mEq/kg), respectively. Aflatoxin content of chicken skin, gizzard powder and ghee residue was 41 ppb, 33 ppb and 7.1 ppb, respectively. The different by-products, liver powder and ghee residue was found most suitable for the incorporation in the formulation of dog food.

Keywords: By-products, proximate composition, poultry, dairy and peroxide value

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Rapid development of food processing industry yields higher abundance and concentration of by-products (Helkar *et al.*, 2016). The by-products of poultry and dairy industry are rich in nutrients. Disposal of these by-products as a waste material constitutes a major ecological burden because of very high biochemical oxygen demand (BOD).

The main by-products of egg processing includes hatchery by-products consisting of egg shells, infertile eggs, unhatched eggs and dead as well as culled chicks. The common use of hatchery by-product is in the poultry feed upto 3–5% level. Different dairy industry by-products such as whey, skim milk, ghee residue etc. are produced during the manufacture of main dairy products, which are rich in nutrients and of great economic value. Ghee residue is important by-product of dairy industry, generally it is utilized in preparation of candy, chocolate, edible paste for sandwich, dosa and samosa filling, burfi and bakery products. Kaur *et al.* (2021) also utilized Dal churi as a source of proteins in dog diet.

Under the present study the nutritional and physico-chemical quality of different poultry and dairy industry by-products such as chicken skin, liver powder, gizzard powder, hatchery waste and ghee residue was evaluated to explore the potential for the inclusion in the pet foods.

The by-products *i.e.* chicken skin, liver, gizzard, hatchery waste and ghee residue was procured from instructional poultry processing unit, hatcheries and

College of Dairy Science and Technology, GADVASU, respectively. Poultry liver and gizzard were collected from the healthy birds after their slaughter and thorough postmortem examination. These were minced in the meat mincer (Mado Eskimo Mew-714, Mado, Germany). Minced poultry liver and gizzard were air dried at 60 °C for 15-16 h. in industrial tray dryer. After drying, the by-products were converted into powder form with help of grinder separately. These were stored in PET jar for the subsequent use.

Proximate analysis and mineral estimation

The procured samples were analyzed for proximate composition *viz.* dry matter (DM), crude protein (CP), ether extract (EE), total ash (TA), acid insoluble ash (AIA), crude fiber (CF) and phosphorus as per AOAC (2005) and calcium as Talapatra *et al.* (1940).

Physicochemical properties

The pH, Free Fatty acid (FFA), peroxide value was estimated. The pH of meat, egg and dairy industry by-products samples was determined as per the method described by Trout *et al.* (1992). The free fatty acids and peroxide value was estimated by the method of Koniecko (1979).

Statistical analysis

The data was analyzed statistically on "SPSS-16.0" (SPSS Inc., Chicago, II USA) software package and Design Expert software as per standard methods (Snedecor and Cochran, 1994). The statistical significance was

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estimated at 5% level ($p < 0.05$) and evaluated with Duncan's Multiple Range Test (DMRT).

RESULTS AND DISCUSSION

Proximate and mineral estimations of different by-products

The results for the proximate and mineral estimations of different poultry and dairy industry by-products such as chicken skin, liver powder, gizzard powder, hatchery waste and ghee residue is presented in Table 1.

Among the poultry industry byproducts, liver powder has 60% crude protein, 18% EE, 0.6% crude fibre and 7.52 % total ash on dry matter basis. Gizzard powder was analyzed for its proximate composition and was found of having 58.6% crude protein, 17.45% EE, 0.75% crude fibre and 7.44% total ash. Chicken skin have 12.94% crude protein, 20.13% EE, 2.6% crude fibre and 3.50 % total ash. Hatchery waste was also analyzed for its proximate composition and have 22.73% crude protein, 4.06% EE, 10.8% crude fibre and 23.6% total ash. Among dairy industry by-products, ghee residue has 25.37% crude protein, 43% ether extract and crude fibre 0.4%. Ramesh *et al.* (2018) also reported that moisture, crude protein, crude fibre, ether extract, nitrogen free extract and total ash contents of ghee residue are 12.10, 19.86, 3.49, 47.12, 25.63 and 3.90 per cent, respectively.

The crude protein content in chicken liver powder and gizzard powder was significantly ($P < 0.05$) higher than the other byproducts, whereas the ether extract content of the ghee residue was higher than other by-products. Crude fibre content was highest in the hatchery waste, whereas the lowest was reported in the ghee residue. Ash content was reported highest for the hatchery waste as it includes the broken out egg shells. Calcium content was significant ($P < 0.05$) higher than the other by-products in hatchery

waste, whereas the lowest value was reported for the chicken skin. Phosphorus content was highest in the gizzard powder.

Physicochemical properties of different by-products

Different by-products *viz.* chicken skin, liver powder, gizzard powder, ghee residue and hatchery waste were analysed for physiochemical properties (pH, free fatty acid and peroxide value). The results are presented in statistically analysed Table 2. pH value of all ingredients was found to be in acidic range. The pH values of gizzard powder significantly ($P < 0.05$) lower than all other by-products. Peroxide value and free fatty acid content was determined to check the rancidity of fat content in dog food ingredients. Free fatty acid content of all by-products except lard was less than the critical limits ranging from 0.46 to 1.11 % which indicate that ingredient were of good quality. Peroxide value of ghee residue, liver powder, gizzard powder, chicken skin and hatchery waste was 2, 2, 4, 6 and 6 (mEq/kg), respectively. Peroxide value and free fatty acid content of hatchery waste was significantly ($P < 0.05$) higher than the other byproducts. Osawa *et al.* (2008) reported the value of FFA and PV of pet food in the range of 4.6 ± 0.1 to $28.0 \pm 0.6\%$ oleic acid and 1.4 ± 0.1 to 6.8 ± 0.3 meq O_2 /kg, respectively. Pearson (1968) stated that minced beef had FFA content in the range of 0.38 to 1.74% and had a maximum acceptability limit of 1.8% FFA in view of their progressive increase during storage.

Aflatoxin content of different by-products

Aflatoxin content of meat, egg and dairy industry by-products (hatchery waste, ghee residue, liver powder, gizzard powder and chicken skin) is depicted in Table 3. Aflatoxin content in liver powder was 21 ppb. High amount of aflatoxin content was present in Hatchery waste i.e. 47 ppb. Aflatoxin content of chicken skin and gizzard

Table 1

Proximate and mineral estimations of poultry and dairy industry by-products (DMB)

Parameters	Byproducts				
	Ghee Residue	Liver Powder	Gizzard Powder	Chicken Skin	Hatchery Waste
Dry matter	88.8±1.62 ^b	94.65±1.85 ^a	94.62±2.51 ^a	30.7±2.38 ^d	53.84±2.62 ^c
Crude protein	25.37±0.83 ^b	60±2.53 ^a	58.6±1.88 ^a	12.94±0.89 ^d	22.73±1.23 ^c
Ether extract	43±1.21 ^a	18±0.13 ^c	17.45±0.25 ^c	20.13±1.68 ^b	4.06±0.92 ^d
Crude fiber	0.41±0.03 ^d	0.62±0.04 ^c	0.75±0.08 ^c	2.61±0.32 ^b	10.8±1.62 ^a
Ash	3.98±1.42 ^c	7.52±0.68 ^b	7.44±0.72 ^b	3.50±0.21 ^c	23.6±1.23 ^a
Acid insoluble ash (AIA)	0.08±0.01 ^d	0.10±0.02 ^d	0.30±0.06 ^c	0.96±.05 ^b	3.20±0.62 ^a
Calcium	1.50±0.07 ^b	0.40±0.04 ^c	0.43±0.03 ^c	0.11±0.02 ^d	11.6±1.22 ^a
Phosphorus	0.31±0.04 ^c	0.52±0.03 ^b	0.70±0.06 ^a	0.16±0.03 ^d	0.46±0.02 ^b

N=6; The values are given on dry matter basis (DMB).

*Mean±S.E. with different superscripts row wise (small alphabets) differ significantly ($P < 0.05$).

Table 2**Physicochemical properties of different by-products**

Ingredients	pH	FFA (% oleic acid)	PV (mEq/kg)
Ghee Residue	6.1±0.06 ^a	0.75±0.05 ^c	2.0±0.32 ^c
Liver Powder	5.7±0.05 ^b	0.46±0.07 ^c	2.0±0.85 ^c
Gizzard Powder	3.6±0.03 ^d	0.67±0.02 ^d	4.0±0.61 ^b
Chicken Skin	4.8±0.03 ^c	0.91±0.08 ^b	6.0±0.26 ^a
Hatchery waste	6.7±0.05 ^a	1.11±0.08 ^a	6.0±0.52 ^a

N=6; *Mean±S.E. with different superscripts column wise (small alphabets) differ significantly (P<0.05).

Table 3**Aflatoxin content of the different by-products**

Ingredients	Aflatoxin (ppb)
Liver Powder	21±1.34 ^d
Ghee Residue	7.1±0.88 ^e
Hatchery waste	47±2.56 ^a
Gizzard Powder	33±1.72 ^c
Chicken Skin	41±2.47 ^b

N=6; *Mean±S.E. with different superscripts column wise (small alphabets) differ significantly (P<0.05).

powder was 41 ppb and 33 ppb, respectively. Lowest aflatoxin content was present in ghee residue (7.1 ppb).

On the basis of proximate analysis, physico-

chemical properties and aflatoxin content in the different by-products, liver powder and ghee residue was found most suitable for the incorporation in the formulation of dog food.

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