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EFFECT OF PROCESSING CONDITIONS OF HYDROLYSED FEATHER MEALS ON THE ENERGY REQUIREMENTS AND QUALITY PARAMETERS

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ABSTRACT

Chicken feather meal represents a large potential source of protein for feed use. In Egypt, the volume of available dry feathers annually at processing plants has been estimated as 0.70 million tons (Ministry of Agriculture, 2001), which if made available for feed use, could do much to supply amino acids in poultry diets. The present study was undertaken to investigate the effect of processing conditions of feather meals such as, steam pressures (225,275,325 and 375 kPa), heating times (15,30,45 and 60 min), and two different treatments of feather (chopped and complete) on the energy requirements, and cost analysis of feather meals. Feather meals quality of the tested methods were also considered.

The maximum machine productivity were obtained under 375 kPa steam pressure for 60 min of cooking time during milling chopped feathers which were 0.429 ton/h. Milling chopped feather, at steam pressures of 225 kPa and cooking time of 15 min the total consumed specific energy (kW.h/ton) for feather milling were reduced by about 48.8 % than that needed when processing complete feathers. Meanwhile, at higher steam pressures of 375 kPa and 15 min of cooking time, the total consumed specific energy for feather milling reduced with about of 74.8% than that using a complete feather. Increasing of steam pressures and cooking times for autoclaving chopped feathers resulted in a gradually increase in the chemical composition of (CP, EE and ash), and a slightly higher values for amino acids recovery of feathers. The results of the analysis of variance indicated that best ever result was obtained at 225 kPa of steam pressure and 60 minutes of cooking time. At these levels maximum protein (CP) content (89.213 and 89.197 %)., for chopped and complete feathers respectively were obtained. Processing costs for producing one tonne of feather meals using complete feathers is about 18.3 % larger than that the chopped feathers.

INTRODUCTION

Feeding and selecting the proper poultry diet is one of the most serious problems facing poultry producers. Poultry needs a relatively high amount of protein in its diet, and proteins is considered as the most important and expensive part of the diet. Therefore, encouraging production of local animal protein sources should be given much consideration, in order to improve the production of new and non-conventional sources of protein for poultry feeds. (Academy of Sci. Res. and Tech., 1992)

In recent years, poultry by-product meals had been tested in poultry diets as a non-conventional source and to substitute or supplement the expensive conventional sources of proteins (meat and fish meal). Poultry by-product

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meal provides a good potential as animal protein source for poultry feeding. Converting wastes of poultry processing plants into non-conventional feedstuffs still a major problem in Egypt. On the other hand, the potential of feather by-product wastes reach about 0.70 million ton/year, which if processed may help to cover part of the shortage of animal feeding (Ministry of Agricultural, 2001). Feather meal, however, contains about 85 to 95% crude protein. Very few studies were carried out in an attempt to make this protein available to poultry Wessels (1972), Baker et al. (1981).

Several processing methods have been evaluated in an attempt to reduce the cost of production. Feather processing with autoclaving hydrolysis seems to be the common method used for feather meal production comparing with other methods, which use alkali, or enzyme treatments as reported by Papadopoulos et al. (1985), Tadtiyanant et al. (1993), Abdel-Hakim (1998) and Abou-Khashaba (1999). Abdel-Hakim (1993) concluded that, the feather meal treated with autoclaving recorded the highest values, while the lowest were obtained for feather meal treated with either cooking or NaOH.

Academy of Sci. Res. and Tech. (2001) reported that processing poultry by-product by autoclaving hydrolysis method could provide several advantages: Improving the final quality of the product, which will be free from diseases sources, and completely destroy all of the anceraks bacteria, cholera of pork, doge virus and all salmonella kinds. Hence, processing method with autoclaving cooking consider as the save methods for recycling the dead poultry residue into feedstuff for poultry. This is because the final product could be considered as a free from pathogenic diseases.

Morris and Bolloum (1973), stated that ground raw feathers failed to support growth regardless of amino acid supplementation, as did feathers autoclaved for 30 min. at 121 C and supplemented with amino acids supported moderate chick growth. They also added that raw feathers autoclaved at 121 C for 18 hours were not optimally processed as evidenced by the inability to promote weight gain equal to the commercial meal. Heating time required to obtain a satisfactory product is known to increase rapidly as temperature is lowered below 142C.

Burgos et al. (1974), MacAlpine and Pyne (1977), and Southern and Gawain (1981) reported that. Subjecting the meal to proper cooking pressure from 207 to 241 kPa for 30 - 60 min could produce a meal of high digestibility and all amino acids are well utilized

Latshaw (1990) studied the effect of changing the PH from 5 to 9 and / or heating by steam at pressures of 207 - 345 kPa for 30 min. He found that higher steam pressure during heating or longer heating time increased the digestibility of feather protein. These results were in line with Haque et al. (1991).

Mohamed et al. (1991) investigated the effect of processing conditions on the nutritional quality of hydrolyzed feather meal (HFM). They concluded that, HFM contains high levels of methionine, lysine and histdine which were the first, second and third limiting amino acid, respectively. Higher temperature resulted in slightly higher values for crude protein, gross energy and amino acid recovery of the processed meal, while their cystine contents were relatively lower. Meanwhile, Abou-Khashaba (1999) revealed that feather meal was used to replace a limited quantity of various protein feedstuffs in practical poultry rations. The value of feather meal depends largely on its protein quality, which is greatly influenced by the processing methods and the ability of other dietary ingredients to compensate for nutrient deficiencies of feather meal.

Hegazy (1999) concluded that both milling productivity and efficiency were always increased gradually as the revolving speed of hammer mill increase from 1500 to 3000 r.p.m, and decreased gradually as hammer edge angle increased from 45 to 90 degree. But this increase in machine productivity and efficiency were always higher during chopped feather grinding comparing with complete feather. Total power and energy requirements for chopping and milling feather at 1500 r. p. m. drum speed and 45 deg of hammer edge angled were reduced by about 35.5 % and 41.2 % respectively than that needed when processing complete feathers. Hydrolyzed of chopped feather improved most of essential and non-essential amino acids comparing with completeness.

Abdel-Hakim (1998) stated that the variability in quality of poultry by-product meal is due to the raw materials, processing conditions and storage conditions. Also, he added that processing poultry slaughterhouse by-product could provide several benefits: Improving environmental sanitation and lowering pollution, improving price structure, creation of new employment and lowering the imports of expensive feeding stuff. Similar results were concluded by Academy of Sci. Res. and Tech. (2001)

On a recent report, for Academy of Sci. Res. and Tech. (2001) it was mentioned that, research on poultry by-product meal produced in Egypt is very lacking, regarding the nutritive value of these by-products and/or its ability to substitute completely all-conventional protein sources in poultry diets. Also, it is of a great importance to give a more attention to increase the efficiency of processing operations through, controlling the processing conditions, and transferring appropriate technology to the slaughterhouse, by taking into consideration the technological and economical aspects.

The main objectives of this research work were to:

- Investigate the effect of some processing conditions such as steam pressures (225, 275, 325, and 375 kPa.), heating times (15,30,45 and 60 min), and two different treatments of feathers (chopped and complete) on the energy requirements, and feather meal quality.
- Study the effect of these variables in reducing cost of feather meal production.

MATERIAL, EQUIPMENTS AND EXPERIMENTAL PROCEDURE

This experiment was carried out at Gemmiza Animal Production Research Station, Gharbia Governorate.

MAETRIALS:

White feathers of broiler chicks was used (about 30 kg). This feather was obtained from a local poultry processing plant, approximately one hour after plucking.

EQUIPMENTS:

Chopping machine (cylinder-type) was used to chop the raw feather samples. Machine specification and operating parameters are listed in table (1).

Table (1): specification of milling and chopping machines used in this study.

Specifications	Milling machine	Chopping machine
- Made;	Locale	Italy
- Type	Swinging beaters	Cylinder type
- Knives No.,	---	4
- Hammers No.	16	---
- Screen size, mm;	2 - 3	---
- Power source;	Three phases electric motor	Three phases electric motor
- Power req, HP (kW);	3 (2.24)	5 (3.75)
- Operating speed, r.p.m.	3000	1400

A local hammer mill (swinging beaters-type) was used to mill the treated feathers. Machine specification and operating parameters are listed in table (1).

A stainless steel cooker (autoclave) Russian made, was used to process the feather samples; a spherical unit (BR 75-type) of a radius of 19.8 cm. The upper hemisphere cover was fastened to the lower hemisphere with bolts that is to be removed when loading and unloading samples. The maximum steam pressure and temperature inside the autoclave were 4.5 kgf /cm^2 and 135 C respectively according the manufacturing catalog.

Test Procedures for Preparation and Processing Feather Samples:

The feather meal was processed in a batch-type cooker at different steam pressure (cooking pressure) from 225 to 375 kPa. For 15, 30, 45, and 60 min as follows:

White feathers samples were cleaned with water fresh, freed from foreign matter, and sun dried.

After drying, the feathers sample was divided into two parts. The first part was stored as it is, while the second part was chopped using cylinder-type chopping machine. The chopped and complete feathers were stored until the processing operation. Just before processing the feather samples (chopped and complete) thoroughly mixed with water to rise the moisture content to a level of 20% $\pm$ 1 (d.b), packed in a wire mesh basket to helps the steam to penetrate the feather, then put inside the autoclave.

After closing the autoclave, the air was vented, and the pressure raised as quickly as possible to the required levels of steam pressure (cooking pressure) (225, 275, 325, and 375 kPa.) for 15, 30, 45, and 60 min after reaching the pressure. Then, the pressure was released and the autoclave allowed to reach the atmospheric level. Samples of cooked feathers were dried in a forced air oven at 60 C^o , and the dried material was grounded in a local hammer mill.

MEASUREMENTS:

During feathers milling, the consumed time from the moment of full dropping of feather until the end time was measured, and samples of grounded feather were taken periodically from the machine outlet in polyethylene sacks and the amount of grounded feather was determined. Three replicates of this procedure was carried out. Then the machine productivity (ton/ h) and energy (kW.h/ ton) were estimated for each test. The quality of the hydrolyzed feather meal was also considered.

Estimation of energy requirements:

The consumed power (kW) for chopping, cocking and milling operations was estimated by using super clamp meter (700-k type). Total and active powers were then estimated according to (Kurt, 1979) as follow:

Total consumed power under machine working load (P).

$$P = \sqrt{3} \, . \, I \, . \, V \, . \, \eta \, . \, \cos\Theta / 1000 \qquad kW$$

Where:

I = line current strength in Amperes;

V = potential difference (voltage) being equal to 380 V;

η = mechanical efficiency assumed (95 %);

$\cos\Theta$ = power factor (was taken as 85%).

Specific energy requirements (kW. H /ton), was calculated as follows:

Energy req. = Cons. power (kW)* Time (h) / Machine prod. (ton)

Feather Meals Quality Evaluation:

To asses the effect of different processing conditions on the feather meal quality, a chemical analysis and amino acid determination was undertaken in the laboratories of Poultry Nutrition Section, Animal Production Research Institute Ministry of Agricultural.

The proximate analysis of different samples was carried out for ash, crude protein (CP), ether extract (EE) and crude fiber (CF) according to AOAC (1984). The amount of N-Free extract (NFE) on dry matter basis was obtained by the difference from initial weight of the samples.

The amino acids composition of a feed protein is a good indicator of the potential nutritive value. Amino acid percentages were determined by oxidizing of the protein with performic acid and acid hydrolysis using 6NHCL at 110 C^o for 22 hours and then extraction of free amino acids. Amino acid concentrations were measured with a Beckman 7300 high performance Amino Acid Analyzer (AOAC (1984).

Cost Analysis:

Cost evaluation was performed considering the method of estimating both ownership cost (fixed costs) and operating costs (variable costs), as described by ASAE (1992) and Sirvastava (1995) according to price level of 2002.

Ownership costs:

The ownership costs (Fixed cost) of the machine include depreciation, interest on investment, taxes, shelter and insurance. It was calculated as follow:

$$C_{oa} = P_u \, [\, (1 - S_v) \, \{ I_r \, (1 + I_r)^{\tau L} / (1 + I_r)^{\tau L} - 1 \, \} + (\, K_{tis} / 100) \,]$$

Where:

C_{ra} = total annual ownership costs, LE / yr;

P_u = Purchase price of machine, LE;

I_r = real annual interest rate, decimal;

τL = economic life of machine, years;

S_v = salvage value as fraction of purchase price;

K_{tis} = annual cost of taxes, insurance and shelter as percent of purchase price (Assumed to be 2% of the P_u).

Operating costs (variable costs):

Operating costs include repair, maintenance, electricity cost, and labor cost. Variable costs were calculated for chopper, cooker and mill as the following assumption:

- Repair and maintenance cost = 90% of depreciation;
- Electricity cost (LE/h) = energy cons. (kW/h) × price (LE);
- Labor costs (LE/h) = wage (LE/h) × number;
- Grease and daily services = 1% of the P_u;
- Purchase price (P_u) = 2500 LE; for autoclaving
  = 4000 LE; for chopping machine;
  = 3700 LE; for milling machine
- Salvage values (S_v) = 10 % of the P_u;
- Interest rate (I_r) = 12 % of the P_u;
- Machines economic life (L) = 2000 hours = 10 years;
- Price of commercial electricity = 0.14 LE/ kW;
- Yearly operation, hours = 200 h.;
- Autoclaving capacity (average) = 60 kg/h. for chopped feathers;
  = 42 kg/h. for complete feathers.
- Chopping capacity (average) = 240 kg/h. for chopped feathers.
- Milling capacity (average) = 175 kg/h. for complete feathers;
  = 326 kg/h. for; chopped feathers.

Total machine costs = the ownership costs + operating costs --------- (LE / h).

Total machine costs = total costs (LE/ h) / Machine prod. (ton / h) --- (LE / ton).

Statistical Analysis:

As mentioned above, feather meal represents a large potential source of protein for feed use, and proteins is considered as the most important and expensive part of the diet. Hence, the statistical analysis were carried out for protein ratio. The statistical analysis was computed using analysis of variance procedure according to procedures outlined by SPSS program (1997).

RESULTS AND DISCUSSION

Milling Productivity:

The effect of feather meal processing conditions (steam pressures, and heating or cooking time) during milling two treatments of hydrolysed poultry feathers complete (F1) and chopped (F2) on machine productivity (ton /h) were shown in Fig. (1).

In general, it can be seen that, increasing steam pressures during cooking process of feathers from 225 to 375 kPa at all cooking times in the range of 15 to 60 min cause a corresponding increase in the machine productivity for complete and chopped feathers as shown in Fig. (1).

Data shown in Fig. (1) also, indicated that at different steam pressures from 225 to 375 kPa milling productivity were always increased gradually as heating times increase from 15 to 60 min. It can also be seen that the increase in machine productivity at chopped feathers were always higher than milling productivity of complete feathers.

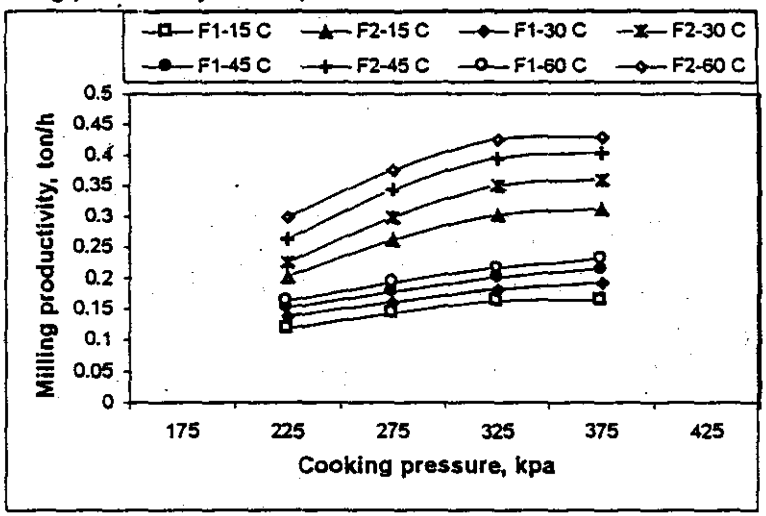

Fig. (1): Milling productivity as affected by different cooking times and different cooking pressures using shopped and complete feathers.

Generally, data in Fig. (1) showed that, the maximum machine productivity for chopped feathers 0.429 ton / h. was obtained under 375 kPa steam pressure and 60 min cooking time. Meanwhile, the lowest milling productivity 0.117 ton / h was recorded when processing feathers at 225 kPa for cooking time of 15 min, when using complete feathers.

This increase in machine productivity between chopped and complete feather may be attributed to the chopping process of feather and to the increases of feathers softness as the result of feathers cooking.

In other words one may say that, chopping process reduce the feather lengths and this in turn reduced the time needed for fine grinding.

Also, the increases in machine productivity by increasing of steam pressures and cooking time may be attributed to the increase of feathers softness and this increases the cutting efficiency for hammers.

Specific Energy Requirements:

The data indicated that increasing steam pressures from 225 to 375 kPa cause a corresponding increase in the power (kW) and energy (kW.h) requirements as, no-load, loaded and active (useful) power for both types of hydrolysed feather under study (chopped and complete).

In other words, at any steam pressures from 225 to 375 kPa the results showed that, power (kW) and energy (kW.h) requirements increased at all heating times in the range from 15 to 60 min.

Whereas, it can be stated from the data in Fig. (2) that increasing steam pressures from 225 to 325-kPa causes a gradually decrease in the consumed specific energy (kW .h/ ton) during milling complete and chopped feather at any heating times from 15 to 60 min.

Meanwhile, increasing steam pressures from 325 to 375 kPa cause a slightly decreased in the energy requirements during mill chopped and complete feather as shown in Fig. (2).

This decrease in consumed specific energy (kW .h/ ton) by increasing steam pressures and heating times, may be due to a corresponding increase the soften of feathers as the result of feathers cooking and this cause an increases in the machine productivity.

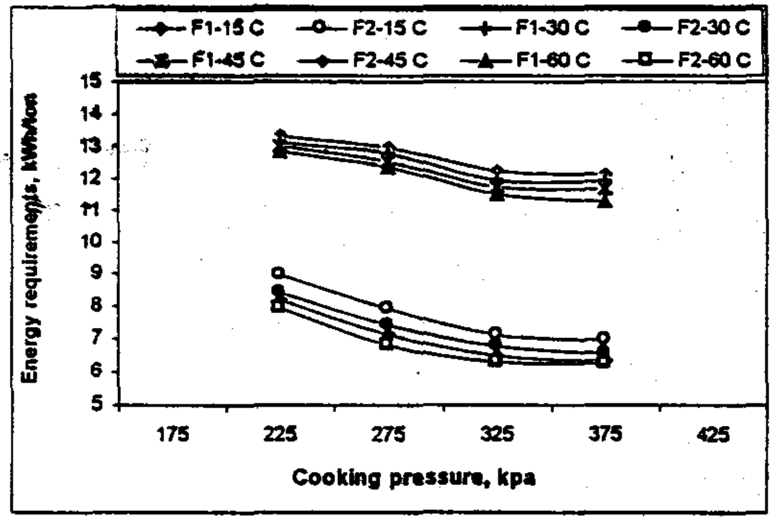

Fig. (2): Specific energy consumed as affected by different cooking times and cooking pressures using chopped and complete feathers.

Generally, data reported in Fig. (2) show that, the highest level of energy consumption was recorded at steam pressures of 225 kPa and 15 min. of cooking time. In other words, the data revealed that, milling chopped feathers at steam pressure of 225 kPa and cooking time of 15 min the total energy for feathers milling were reduced by about 48.8 % than that needed when processing complete feathers. Meanwhile, at higher steam pressures of 375 kPa and cooking time of 15 min, the total energy needed for feather milling reduced with about of 74.8 % than that using a complete feather.

Feather Meals Quality Evaluation:

Data in Tables (2 and 3) show the relation between the chemical composition of feather meals and amino acids composition as affected by different experimental variables. The results of the statistical analysis revealed that, there was no significant difference between steam pressures treatments and values of crude protein (CP). On other wards, the analysis of variance indicated that best ever result was obtained at 225 kPa of steam pressure and 60 minutes of cooking time. At these levels maximum protein (CP) content (89.213 and 89.197 %)., for chopped and complete feathers respectively were obtained.

Amino acids rather than total protein requirements it is primary consideration in formulating poultry rations. Therefore, amino acid content of the feed ingredients should be taken in consideration.

Table (2): The proximate analysis (dry basis) of feather meals as affected by different processing conditions.

Cook. Time (min)	Chem. Comp. (%)	Cooking pressure (Kpa)							
		225		275		325		375	
		F_1^*	F_2^{**}	F_1^*	F_2^{**}	F_1^*	F_2^{**}	F_1^*	F_2^{**}
15	CF	1.968	1.945	1.958	1.930	1.949	1.923	1.943	1.915
	CP	89.190	89.203	89.195	89.209	89.197	89.210	89.198	89.211
	EE	4.620	4.625	4.622	4.628	4.624	4.628	4.626	4.628
	Ash	3.610	3.612	3.611	3.614	3.613	3.619	3.616	3.620
	NFE	0.612	0.610	0.614	0.619	0.617	0.620	0.614	0.626
30	CF	1.964	1.946	1.951	1.925	1.944	1.926	1.943	1.923
	CP	89.192	89.205	89.196	89.210	89.198	89.213	89.198	89.213
	EE	4.623	4.626	4.624	4.630	4.625	4.627	4.625	4.627
	Ash	3.613	3.614	3.616	3.617	3.618	3.618	3.618	3.618
	NFE	0.608	0.609	0.612	0.618	0.615	0.615	0.616	0.615
45	CF	1.960	1.939	1.941	1.921	1.936	1.915	1.933	1.910
	CP	89.195	89.208	89.199	89.211	89.201	89.213	89.203	89.213
	EE	4.642	4.628	4.634	4.632	4.635	4.636	4.635	4.636
	Ash	3.617	3.620	3.618	3.626	3.620	3.625	3.621	3.628
	NFE	0.604	0.606	0.608	0.610	0.608	0.611	0.608	0.611
60	CF	1.957	1.933	1.941	1.921	1.935	1.911	1.930	1.916
	CP	89.197	89.213	89.199	89.213	89.199	89.213	89.199	89.213
	EE	4.627	4.631	4.634	4.636	4.632	4.637	4.636	4.636
	Ash	3.617	3.623	3.621	3.626	3.624	3.629	3.625	3.628
	NFE	0.602	0.600	0.605	0.604	0.610	0.608	0.610	0.611

F_1^* = Complete feathers; F_2^{**} = Chopped feathers

The data also revealed that the chemical composition of feather meals as poultry by-product varied from meal to another according to the method of processing. At any cooking time from 15 to 60 min. increasing steam pressures from 225 to 375-kPa causes a corresponding increase in the values of crude protein (CP), ether extract (EE), and ash content, (%.) during milling complete and chopped feathers, meanwhile, the values of crude fiber (CF) were decreased at the same processing conditions as shown in Table (2).

At any cooking time from 15 to 60 min increasing steam pressures from 225 to 375-kPa causes a corresponding increase in the amino acids compositions of hydrolysed feathers (chopped and complete) as shown in Table (3).

It can be seen that, at the same conditions of autoclaving process a gradually higher values were found in amino acids recovery using chopped feather than that of the complete and raw feathers. This increase in amino acids composition using a chopped feathers comparing with complete feathers may be attributed to increasing the surfaces area of feathers as a result of chopping process and this may be improve the amounts of feathers amino acids recovery.

Table (3): Amino acids composition of feather meals as affected by different processing conditions.

Cook. Time (min)	Amino Acids Comp., (%.)	Raw Feath.	Cooking pressure (Kpa)							
			225		275		325		375	
			F_1^*	F_2^{**}	F_1^*	F_2^{**}	F_1^*	F_2^{**}	F_1^*	F_2^{**}
	Aspartic	4.20	5.103	5.460	5.154	5.487	5.180	5.542	5.194	5.558
	Theronine	3.13	4.102	4.389	4.143	4.411	4.164	4.455	4.176	4.463
	Serine	6.25	8.415	8.835	8.499	8.879	8.541	8.960	8.566	8.994
	Glutamic	9.41	9.547	10.215	9.642	10.564	9.690	10.355	9.718	10.396
	Proline	6.42	7.956	8.522	8.045	8.565	8.084	8.644	8.108	8.672
15	Alanine	3.11	3.804	3.956	3.842	3.976	3.861	4.011	3.872	4.025
	Valine	6.01	6.524	6.687	6.559	6.720	6.622	6.785	6.640	6.803
	Methionine	0.04	0.574	0.603	0.579	0.606	0.582	0.610	0.584	0.614
	Lysine	1.85	2.190	2.299	2.212	2.310	2.223	2.333	2.229	2.335
	Histidine	0.74	0.783	0.802	0.791	0.806	0.794	0.811	0.797	0.816
	Arginine	6.10	6.851	9.368	6.919	9.415	6.953	9.501	6.970	9.533
	Aspartic	4.20	5.113	5.471	5.159	5.490	5.182	5.545	5.195	5.559
	Theronine	3.13	4.110	4.398	4.147	4.414	4.167	4.457	4.177	4.465
	Serine	6.25	8.431	8.853	8.502	8.885	8.544	8.966	8.570	8.995
	Glutamic	9.41	9.566	10.235	9.650	10.571	9.692	10.360	9.721	10.397
	Proline	6.42	7.980	8.539	8.051	8.570	8.088	8.650	8.116	8.671
30	Alanine	3.11	3.812	3.964	3.845	3.977	3.862	4.015	3.785	4.026
	Valine	6.01	6.537	6.700	6.565	6.722	6.623	6.790	6.644	6.804
	Methionine	0.04	0.575	0.604	5.580	6.607	0.583	0.611	0.585	0.614
	Lysine	1.85	2.194	2.304	2.214	2.312	2.223	2.335	2.223	2.336
	Histidine	0.74	0.784	0.803	0.792	0.807	0.795	0.812	0.797	0.818
	Arginine	6.10	6.865	6.879	6.922	9.424	6.955	9.503	6.972	9.534
	Aspartic	4.20	5.120	5.479	5.163	5.496	5.187	5.550	5.197	5.260
	Theronine	3.13	4.116	4.404	4.152	4.419	4.172	4.461	4.179	4.466
	Serine	6.25	8.440	8.860	8.510	8.892	8.550	8.972	8.547	8.997
	Glutamic	9.41	9.580	10.250	9.610	10.581	9.700	10.370	9.722	10.399
	Proline	6.42	7.992	8.542	8.062	8.581	8.092	8.652	8.119	8.672
45	Alanine	3.11	3.815	3.966	3.850	3.982	3.865	4.180	3.787	4.029
	Valine	6.01	6.540	6.704	6.572	6.730	6.626	6.794	6.647	6.806
	Methionine	0.04	0.576	0.605	5.583	6.610	0.584	0.612	0.586	0.616
	Lysine	1.85	2.197	2.306	2.216	2.315	2.224	2.337	2.225	2.338
	Histidine	0.74	0.785	0.804	0.793	0.808	0.796	0.813	0.797	0.818
	Arginine	6.10	6.870	6.882	6.930	9.432	6.960	9.510	6.976	9.535
	Aspartic	4.20	5.121	5.480	5.164	5.497	5.188	5.551	5.198	5.261
	Theronine	3.13	4.117	4.405	4.153	4.420	4.173	4.462	4.180	4.467
	Serine	6.25	8.442	8.862	8.512	8.894	8.552	8.974	8.549	8.989
	Glutamic	9.41	9.582	10.252	9.612	10.583	9.702	10.372	9.724	10.401
	Proline	6.42	7.994	8.544	8.064	8.583	8.094	8.654	8.121	8.672
60	Alanine	3.11	3.816	3.967	3.851	3.983	3.866	4.181	3.788	4.030
	Valine	6.01	6.541	6.705	6.573	6.731	6.627	6.795	6.648	6.807
	Methionine	0.04	0.576	0.605	5.584	6.611	0.584	0.612	0.586	0.616
	Lysine	1.85	2.197	2.306	2.216	2.315	2.224	2.337	2.225	2.338
	Histidine	0.74	0.785	0.804	0.793	0.808	0.796	0.813	0.797	0.818
	Arginine	6.10	6.871	6.883	6.931	9.434	6.961	9.512	6.977	9.535

F_1^* = Complete feathers; F_2^{**} = Chopped feathers

Cost Analysis

Cost analysis was carried out for all processing operation (chopping, cooking and milling), considering the treatment produced the maximum value of crude protein (89.213 %).

Two parameters were calculated as the absolute total costs including both ownership machinery costs and operating costs per hour according to the standard methods described in the ASAE (1992) and .Sirvastava (1995). and price level of 2002 as shown in Table (4).

Table (4): The costs of feather meal processing equipments.

COST ARTICLES	CHOPPING EQUIP.	COOKING EQUIP.	MILLING EQUIP.	TOTAL PROCESS COSTS
-Total ownership costs (L.E/ h).	4.60	2.87	4.25	
Operating costs (L.E / h).				
Repair and maintenance,	2.64	1.52	2.45	
Grease and daily services,	0.33	0.20	0.30	
Electricity cost,	0.35	0.80	0.41	
Labor costs.	1.50	1.50	1.50	
- Total operating costs.	4.82	4.02	4.66	
- Total machine costs (LE/ h).	9.42	6.89	8.91	---
- Total machine costs (LE/ ton).				
- For complete feathers;	---	164.0	50.91	2i4.91
- For chopped feathers.	39.25	115.0	27.33	181.58

If the comparison was made between the two processing treatments (Chopped and complete feathers) as shown from the data presented in Table (4), the costs of processing one tonne of feather meals using complete feathers is about 18.3% larger than that chopped feathers.

This decreased in feather meals processing using chopped feathers may be attributed to increases in machine productivity by increasing of steam pressures and cooking time, and this increase the milling efficiency and decrease the time needed for feathers milling, consequently the costs of feather meals processing was decreased. This would result in saving an appreciable high amount of money, which could be invested in somewhere else

CONCLUSION

-The results of the analysis of variance indicated that best ever result was obtained at 225 kPa of steam pressure and 60 minutes of cooking time. At these levels maximum protein (CP) content (89.213 and 89.197 %)., for chopped and complete feathers respectively were obtained.

-The maximum milling productivity was obtained under 375-kPa steam pressures for 60 min of cooking time during milling chopped feathers,which were 0.451 ton/ h.

-Total energy requirements for chopping, cooking and milling feather using steam pressures of 225 kPa and time cooking of 15 min were reduced by about 26 % than that needed when processing complete feathers at steam pressures of 375 kPa and for 15 min.

-Chemical composition and amino acids recovery of feather meals as poultry by-product varied from meal to another according to the method of processing. Also, hydrolyzed of chopped feathers improved the amino acids comparing with that of complete and raw feathers.

-The cost of processing one tonne of feather meals using complete feathers is about 18.3 % larger than that chopped feathers.

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الملخص العربي

تأثير ظروف تصنيع وجبات الريش المحلل مائيا على احتياجات الطاقة وخصائص الجودة

د٠كريم السيد صالح حجازي* ، د حمدي عبد العزيز أبو خشبه**

نظرا لوجود فجوة كبيرة بين الإنتاج والاستهلاك في أعلاف الدواجن (خاصة الأعلاف المركزة) والتي ينعكس أثرها على زيادة سعر وحدة الإنتاج منها، وتمشيا مع سياسات الدولة في فتح مجالات جديدة للاستثمار، وتقليل تكاليف الإنتاج، وتقليل معدلات التلوث البيئي، تم اللجوء لإنتاج أعلاف حيوانية غير تقليدية، من الريش المتخلف بمجازر الدواجن كمنتج ثانوي والتي تصل كميته إلى ٧ و٠ مليون طن سنوياً (الإدارة العامة لإحصاءات الثروة الحيوانية والداجنة والسمكية - وزارة الزراعة - ٢٠٠١). وتعتبر طريقة التحليل المائي للريشAutoclaving hydrolysis من الطرق الشائعة والمستخدمة في التصنيع والتي تجرى لتحويل البروتين الليفي Keratin الموجود بالريش إلى بروتين قابل للهضم تتراوح نسبته بين ٨٥ - ٩٥%٠ أجري هذا البحث بهدف دراسة بعض العوامل المؤثرة على تصنيع وجبات الريش المحلل مائيا تحت ظروف تصنيعية مختلفة، وأثرها على احتياجات الطاقة اللازمة لتحويل وتصنيع هذا الريش إلي أعلاف حيوانية غير تقليدية ، ودراسة خواص الجودة لمسحوق الريش (نواتج طحن الريش المعامل حراريا) وقد اشتملت الدراسة على أربعة مستويات لضغط بخار الماء المستخدم في عملية التسوية (٢٢٥ – ٢٧٥ – ٣٢٥ – ٣٧٥ كيلو باسكال) و أربعة مستويات لزمن التسوية (١٥-٣٠-٤٥-٦٠ دقيقة) باستخدام معاملتين مختلفتين من الريش إحداهما مفرومة آليا والثانية تحتوى على ريش سليم (كامل)٠ كما اشتملت الدراسة على تحليل التكاليف للطرق المختبرة٠

وفيما يلي ملخص لأهم النتائج المتحصل عليها:

- أوضحت الدراسة أن إنتاجية الآلة تزداد بزيادة ضغط بخار الماء المستخدم في عملية التسوية من ٢٢٥ إلى ٣٧٥ كيلو باسكال ، كما تزداد تدريجيا بزيادة زمن التسوية من ١٥ إلى ٦٠ دقيقة ،وذلك عند طحن الريش المعالج حراريا، وكانت الزيادة أكبر ما يمكن عند طحن الريش المفروم و مقارنتها بالريش السليم المعامل عند ضغط ٣٧٥ كيلو باسكال لمدة ٦٠ دقيقة.
- أظهرت الدراسة انخفاض احتياجات الطاقة الكلية المستهلكة لطبخ وطحن الريش المفروم بنسبة ٤٨,٨ % عند مقارنتها بالعينة المحتوية على الريش السليم وذلك عند طبخها تحت ضغط ٢٢٥ كيلو باسكال لمدة ١٥ دقيقة، بينما تنخفض الطاقة بنسبة ٧٤,٨ % وذلك عند طبخها لمدة ١٥ دقيقة تحت ضغط ٣٧٥ كيلو باسكال٠
- أوضحت الدراسة اختلاف نواتج التحليل لوجبات الريش المعامل حراريا من البروتين الخام والألياف باختلاف العوامل التصنيعية المستخدمة في عملية الطبخ٠ وتم الحصول على نسبة بروتين خام (٨٩,٢١٣ %) عند طبخ الريش المفروم تحت ضغط ٣٢٥ كيلو باسكال لمدة ٣٠ دقيقة٠
- وجدت زيادة كبيرة في محتوى نواتج الطحن من الأحماض الأمينية للريش المفروم والسليم عند مقارنته بنواتج التحليل الكيميائي للريش الخام ، وكانت الزيادة كبيرة في محتوى الأحماض الأمينية للريش المفروم عنها في الريش السليم مما سيكون له أكبر الأثر على زيادة الكفاءة الهضمية لهذه الوجبات وذلك نظرا للزيادة الكبيرة في مساحة السطوح للريش المفروم المعرض لظروف الطبخ (الحرارة - الضغط) ٠
- طبقا لنتائج التحليل الإحصائي توصي الدراسة بتصنيع وجبات الريش المحلل مائيا بطبخ الريش المفروم تحت ضغط ٢٢٥ كيلو باسكال لمدة ٦٠ دقيقة لارتفاع نسبة البروتين (٨٩,٢١٣ %) وانخفاض تكاليف إنتاج الطن لوجبات الريش السابق فرمه بنسبة ١٨,٣ % عند مقارنتها بتكاليف العينة المصنعة من الريش٠

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