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Effect of Processing Conditions on the Nutritional Quality of Hydrolyzed Feather Meal

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CHEMICAL and biological assays were carried out to investigate the effect of processing conditions on the nutritional quality of hydrolyzed feather meal (HFM). Autoclaving process with four different conditions , two steam pressures (2.3 bar of 137°C and 1.2 bar of 123°C) each for two processing times (60 and 30 min) were used in preparing samples of HFM .

Higher temperature resulted in slightly higher values for crude protein , gross energy and amino acid recovery of the processed meals, while their cystine contents were relatively lower .

Generally , HFM contains high levels of most of the essential amino acids and low levels of methionine , lysine and histidine which were the first , second and third limiting amino acid , respectively . Processing conditions did not affect the sequence of such limiting amino acids. True protein digestibility values (TPD) were not significantly affected by processing conditions and were in a narrow range from 79.2 to 82.5 %. Although , no significant differences were detected in true metabolizable energy (TME) values among the different processed HFM , the higher processing temperature for 60 min resulted in a slightly lower TME value than those of HFM processed using milder conditions .

Processing conditions did affect the amino acid availability (AAA) values of HFM. Processing temperature was the most significant factor in reducing the mean AAA value. Considrable variation was observed among the individual amino acids , ranging from 37% for aspartic acid to 86% for phenylalanine. Among the critical amino acid cystine was very sensitive to heat and the availability values of lysine , methionine and histidine were also strongly affected by temperature and time of processing .

Cystine content could be used as a reasonable indicator for the processing adequacy of HFM. Strenuous conditions resulted in HFM

of lower cystine content and lower mean amino acid availability values. It could be recommended to use milder processing temperature of about 123 °C for 30 to 60 min to produce HFM of higher AAA and TME values.

The results indicated that the nutritonal quality of protein sources must be measured on the basis of amino acid availability not on their amino acid content or protein digestibility values. This is sufficiently extensive to be taken into consideration in formulating poultry rations.

Key words : Feather meal, Amino acid availability, Processing, true metabolizable energy.

Keratinous proteins such as feathers have a high protein content but are of little nutritive value in their natural state. Because the cystine disulfide bonds within the keratin contribute to the insolubility and indigestibility of this protein, they must be destroyed before feather protein can be digested by the animal. Several processing methods have been used in an attempt to produce a friable meal valid for incorporation in poultry rations. Most of these techniques are based on the method of Binkley and Vasak (1950) and described as a wet cooking or hydrolysis process in which feathers are subjected to steam pressure for a proper time, then dried and ground to produce a meal designated as hydrolyzed feather meal (HFM). Moran *et al.* (1966) treated the raw feather with reducing agents in order to breakdown the feather keratin. For the same purpose, Papadopoulos *et al.* (1985) used sodium hydroxide or proteolytic enzymes then autoclaved the treated feather to produce HFM.

The cooking process must be sufficient to breakdown the feather protein structure but not to the extent of complete hydrolysis of the protein. Some treatments might increase the amino acid content of the processed protein and at the same time reduce the nutritional value of such protein by changing the amino acid pattern or make some amino acids unavailable or partially available to birds. Thus, the amino acid composition of a feed protein may be a good indicator of its potential nutritive value. But, it may at times be misleading especially for protein present in heat processed feed ingredients. It is therefore important to know the biological availability of amino acids in such proteins.

Research work previously carried out have shown that the quality of HFM affected by the processing conditions used, i.e. time, pressure and temperature (Naber and Morgan, 1956; Sullivan and Stephenson, 1957; Wilder, 1972; Morris and Balloun, 1973; Papadopoulos, 1985 and Papadopoulos *et al.*, 1985). These studies have indicated a considerable variation in amino acid availability between feather meals, but factors and conditions causing this variation are hardly quantified.

The present study concerns chemical and biological experiments designed to obtain further information on the effect of processing conditions on some nutritive properties of HFM .

Material and Methods

Processing of HFM

Raw feather obtained from a poultry dressing plant was processed, using a laboratory autoclave , under two various steam pressures (2.3 and 1 .2 bar) for different periods of times (60 and 30 min) i.e. four processed batches were prepared , HFM a, b, c and d. The temperature subsequently decreased from 137 to 123°C with decreasing the steam pressure. Table 1 shows the different conditions used. The process was timed from the time of raising pressure and temperature until releasing the pressure. It consumed 20 min to reach the demand pressure and 10 min for releasing. The processed feather was dried at 60°C in a circulating air oven and then ground. Three kg of raw wet feathers yielded about 750g dried HFM .

Chemical Methods

Dry matter, crude protein (N x 6.25) and ash contents of the tested meals and excreta were determined by methods of the Association of Official Analytical Chemists (1980). Samples of HFM and excreta were hydrolyzed for 24 hr with 6 N H Cl and analyzed for amino acid content (Spackman *et al.*, 1958) using autoanalyzer LKB- 4400. Methionine and cystine were determined after performic acid oxidation (Moore , 1963) followed by acid hydrolysis. The method of Terpstra and De Hart (1974) was employed to separate the faecal and urinary nitrogen in order to estimate the digestible protein. For the energetic parameters , an adiabatic oxygen bomb calorimeter was used to measure the gross energy content of the tested HFM and excreta .

Biological Methods

The bioassays used to measure the nutritive value of the processed HFM were mainly based on Sibbald's methodology for estimation of true metabolizable energy (TME) (Sibbald, 1976 and 1986). Thirty adult cockerels ISA (Semi heavy breed) were housed individually, starved for 24 hr and divided into 5 groups of 6 birds each. Four groups, each were fed one of the four tested HFM and the fifth was kept starved to measure the metabolic faecal and endogenous urinary losses. The fed birds, each was force fed 30g of the tested HFM using a long stem funnel. Excreta were collected quantitatively during the following 48 hr in two times of 24 hr intervals then frozen, freeze dried , weighed (after equilibration with the atmospheric moisture) , ground and kept for different analyses .

Calculation Formulae

Chemical score (CS) was calculated to acertain the amino acid limitation of HFM according to Block and Michell (1946) using chick requirements of NRC (1984) as a

reference. True protein digestibility (TPD) , true amino acid availability (AAA) and true metabolizable energy (TME) values were estimated using the following forumale .

$$TPD = \frac{P_i - (FP_f - FP_s)}{P_i} \times 100$$

$$AAA = \frac{AA_i - (AA_{ef} - AA_{es})}{AA_i} \times 100$$

$$TME = \frac{E_i - (E_{ef} - E_{es})}{I}$$

Where : p_i = protein input, FP_f = faecal protein excreted by the fed bird, FP_s = faecal protein excreted by the starved bird, AA_i =amino acid input, AA_{ef} = amino acid excreted by the fed bird, AAes = amino acid excreted0 by the starved bird, E_i = energy input, E_{ef} = energy excreted by the fed bird, E_{es} = energy excreted by the starved bird and I = g feed input .

Statistical Methods

The data were statistically analyzed by a multivariate analysis of variance and the significant differences among the means were determined using Duncan's new multiple range test outlined by Steel and Torrie (1980).

Results and Discussion

Proximate Composition

The proximate composition (dry matter, crude protein and ash) along with the gross energy value of the processed HFM are shown in Table 1. From the resulted and previously reported values (Papadopoulos *et al*, 1985) it could be concluded that laboratory prepared samples are of hight protein content than those processed in poultry slaughterhouses. This may because raw feather used in the laboratories are usually cleaned and freed from the foreign matters such as feet , heads , offals and/or giblets of the slaughtered birds. These matters contaminate the raw feather in the slaughterhouse and reduce protein content of the processed HFM .

The high protein content of HFM gives it the advantage that when it is used in poultry ration, it takes less HFM than any other protein source to supply the same amount of protein, taking into accoont the amino acid requirements. As a result, more corn can be incorporated in the formula. Accordingly, the amount of added fat needed to supply the same amount of energy is reduced .

TABLE 1. Processing conditions, proximate composition (%dry matter),and gross energy values of the different processed hydrolyzed feather meals.

Item	HFM a	HFMb	HFMc	HFMd
Processing condition				
Pressure (bar)	2.3	2.3	1.2	1.2
Temperature(°C)	137	137	123	123
Time (min)	60	30	60	30
Proximate composition(%)				
Dry matter	92.8	92.06	91.90	91.78
Crude protein	94.20	94.92	92.96	91.92
Ash	0.70	0.66	0.66	0.57
Gross energy (k cal/g)	5.63	5.63	5.55	5.57

Amino Acid Composition

The amino acid composition of the prepared HFM is given in Table 2. High levels of most of the essential amino acids while low levels of methionine, lysine and histidine were observed. Tryptophan was not determined but previous analytical data would suggest, that HFM is also poor in this amino acid (Baker *et al* ., 1981). There is a slight trend for HFM that have undergone the more severe processing conditions to have slightly higher amino acid-N recovery. However, the amino acid composition of different processed HFM with exception of cystine , did not appear to be affected substantially by the processing conditions used. Increased processing time, temperature and pressure do, however decrease the cystine content as a percentage from HFM protein. This finding was in agreement with those of Davis *et al.* (1961), Morris and Balloun (1973) and Papadopoulos (1985) .

The effect of processing conditions on cystine content of HFM was widely studied. Davis *et al.* (1961), Baker *et al.* (1981) and Papadopoulos (1984) observed the presence of the unnatural amino acid, lanthionine, in HFM . The amount found approximated to the loss of cystine during processing suggesting that most of the cystine lost is converted to lanthionine. Thus the destruction of cystine may not be of a completely negative effect since lanthionine is converted to cystine via a metabolic pathway described by Baker *et al* ., (1981). Papadopoulos (1984) suggested that lanthionine is either transformed by the intestinal flora , metabolized or retained in the organism .

The values of methionine, lysine, histidine and phenylalanine of the different processed HFM confirmed the finding of Morris and Balloun (1973) who indicated that there was no apparent increase destruction of methionine or lysine when more strenuous conditions were used. On the same point of view, the chemical method of assessing the amino acid limitation revealed that methionine , lysine and histidine were the first,

second and third limiting amino acids, respectivcly , in the different processed HFM. This also indicates that the processing condition does not affect the sequence of the limiting amino acids. The results of limiting amino acids were similar to those previously obtained by Naber *et al.*, (1961), Baker *et al.*, (1981) and Mohamed *et al.*, (1988).

In general, the present values of amino acid composition of the different processed HFM were within the normal published ranges of Papadopoulos *et al.*, (1985), Sibbald (1986) and Mohamed (1989). Variability in amino acid composition of feedingstuffs is known to be mainly due to the source of raw materials , pretreatment and method of processing used. In addition, method of determination might also be another source of variation .

TABLE 2. Amino acid composition (g/16 g N) of the different processed hydrolyzed feather meals.

Item	HFMa	HFMb	HFMc	HFMd
Aspartic acid	5.70	5.87	5.70	5.68
Threonine	4.63	4.62	4.41	4.30
Serine	11.76	11.59	10.85	11.18
Glutamic acid	10.24	10.13	10.07	9.99
Glycine	6.84	6.77	6.43	6.48
Alanine	4.19	4.16	3.87	3.89
Valine	6.42	6.71	6.80	6.42
Cystine	5.49	5.64	6.30	6.55
Methionine	0.46	0.44	0.46	0.47
Methionine+Cystine	5.95	6.08	6.76	7.02
Isoleucine	5.08	4.68	4.70	4.37
Leucine	8.07	7.47	7.39	7.20
Tyrosine	2.07	2.08	2.25	2.09
Phenylalanine	4.47	4.47	4.44	4.51
Lysine	1.72	1.80	1.71	1.76
Histidine	0.64	0.61	0.59	0.63
Arginine	6.27	6.32	6.29	6.18
Recovery of amino acid-N (%Total N analysed)	84.05	83.36	82.26	81.70
First LAA	Methionine	Methionine	Methionine	Methionine
Second LAA	Lysine	Lysine	Lysine	Lysine
Third LAA	Histidine	Histidine	Histidine	Histidine

Regarding the results of MacAlpine and Payne (1977) who found that at least 57% by weight of the total sulphur amino acid requirement of broiler can be provided by cystine , it could be concluded that the high cystine content of HFM may be considered a useful source of sulphur amino acid and partial replacement of methionine in practical diets. Also, while HFM is poor in lysine, methionine, histidine and tryptophan, these amino acids, with exception of methionine, are present in adequate quantities in rations formulated mainly from soybean meal and corn .

True Protein Digestibility

True protein digestibility values (TPD) of the processing meals (Table 3) showed no significant differences among the different processing conditions and no consistent trend could be related to these conditions .

Energetic Values

The energetic values of the different processed HFM measured as gross energy or true metabolizable energy (TME) did not significantly vary due to the processing conditions used. Regardless of time of processing, the results indicated that higher processing temperature gave HFM of slightly higher gross energy values than those obtained using a lower processing temperature (Table 1). Although no significant differences in TME values detected among the different processed meals, it seemed that higher processing temperature for a longer time of 60 min resulted in ^{HFM} a of a relatively lower TME value than those of the two lower processing temperatures and that of higher temperature for a shorter time of 30 min. However , the present ranges of gross energy (5.55-5.63 Kcal/g) and TME (3.39-3.64 Kcal/g) were in general agreement with the reported ranges (16 samples) of Sibbald (1986) being from 5.57 to 5.93 Kcal /g as gross energy value and from 3.49 to 4.18 Kcal /g as TME value. From the energetic results, HFM could be considered as a rich source of energy for poultry feeding .

Amino Acid Availability

The amino acid availability values corrected for the endogenous amino acid losses of the different prepared HFM are shown in Table 3. The results indicated that processing conditions affected the amino acid availability of HFM. Processing temperature , was the most significant factor in reducing the mean AAA values. Higher temperature for a longer processing time resulted in ^{HFM} a of the lowest mean AAA value being 66.5%. The same temperature for a shorter processing time significantly ($p < 0.05$) increased the mean AAA value of ^{HFM} b to 71.5%. Lower temperature for two processing time (60 and 30 min) resulted in ^{HFM} c and ^{HFM} d with close values of AAA being 77 .17 and 76.17 %, respectively, being significantly ($p < 0.05$) higher than those processed under higher temperature.

The mean amino acid availability value was significantly ($p < 0.001$) affected by temperature of processing. On the other hand , time of processing has no significant effect on the mean AAA of HFM while the interaction between temperature and time was significant ($p < 0.01$). The mean amino acid availability values of HFM were within the published ranges of El-Boushy and Roodbeen (1984), Papadopoulos *et al.*, (1985) and Sibbald (1986). On the other hand these values were markedly lower than those of Burgos *et al.*, (1974), Kirby *et al.*, (1978), Parsons *et al.*, (1982) and El-Sherbiny *et al.*, (1988) who obtained mean AAA values of 95.44, 94.00, 82.20 and 81.60%, respectively .

TABLE 3. True protein digestibility (TPD), true metabolizable energy (TME) and amino acid availability values of the different processed hydrolyzed feather meals and F values[1] of analysis of variance.

Item	HFMa	HFMb	HFMc	HFMd	F-values Source of variation Temperature	Time	Interaction
TPD(%)	79.17	81.50	82.50	79.68			
TME (Kcal/g)	3.39	3.46	3.64	3.50			
Amino Acid Availability(%)							
Aspartic acid	37.33c	49.67b	62.83a	66.67a	230.76***	33.39***	9.23**
Threonine	61.17c	66.67b	73.17a	71.00ab	38.29***		8.44**
Serine	72.17c	76.50b	81.17a	83.00a	71.51***	10.60**	
Glutamic acid	63.00c	68.17b	75.67a	74.33a	63.53***		7.57*
Alanine	74.50	77.33	79.17	77.83			
Valine	78.00b	82.50a	84.83a	82.00a	10.76**		14.52**
Cystine	38.00c	46.00b	64.17a	60.83a	132.36***		10.11**
Methionine	60.00c	68.00bc	70.33ab	73.83a	12.36**	6.26*	
Isoleucine	83.00	85.00	86.17	84.67			
Leucine	78.33	80.17	82.82	76.00			
Tyrosine	66.83b	74.00a	78.33a	76.33a	35.99***	5.02*	15.80***
Phenylalanine	80.33b	83.50a	86.17a	84.33a	16.06***		9.04**
Lysine	57.67c	67.00b	69.50b	75.17a	80.18***	45.10***	
Histidine	68.67c	79.00b	81.00ab	84.33a	71.66***	42.88***	11.25**
Arginine	78.33	81.17	81.83	81.17			
Mean amino acid[2] availability	66.50c	71.50c	77.17a	76.17a	63.73***		11.57**

1- Terms of little significance have been omitted

2- Values present mean of 6 birds for each treatment.

a- c Means with the same superscribte are not significantly different ($p<0.05$)

* $p<0.05$ ** $p<0.01$ *** $p<0.001$

Among the individual amino acids a considrable variation in AAA value was detected in the different processed HFM, ranging from 37% for aspartic acid in HFM_a to 86% for phenylalanine in HFM_c. Cystine recorded the lowest availability value among the critical amino acids through all the processed meals. Lysine, methionine and threonine were of less availability values followed that of cystine. Isoleucine and phenylalanine gave the highest availability values in the different processed HFM. The most frequently limiting amino acids, methionine , lysine and histidine recorded average values of 68. 04, 67. 34 and 78.25%, respectively, of the different processed HFM .

Regarding the sensitivity of the most critical amino acids to processing conditions (temperature and time), the results indicated that cystine is very sensitive to heat, while time of processing had no effect on the availability value of cystine. This result agreed with the finding of Papadopoulos *et al.*, (1985) who demonstrated that cystine was the most heat sensitive amino acid. The availability values of lysine and histidine were also strongly affected by temperature and time of processing. The higher temperature and /or longer processing time the lower availability values. This means that, although the availability of cystime was extremly affected by only processing temperature, the availability values of lysine and histidine were strongly affected by both temperature and time of processing. The significant effect of temperature ($p < 0.01$) and processing time ($p < 0.05$) on the availability values of methionine was lower than those of lysine and histidine ($p < 0.001$) .

These data indicated that temperature has a significant negative effect on the availability values of all amino acids of HFM with the exception of arginine, leucine, isoleucine and alanine. Time of processing significantly affected the availability values of lysine, histidine, methionine, tyrosine, serine and aspartic acid. Cystine content could be used as a reasonable indicator for the processing adequacy of HFM. Strenuous conditions resulted in HFM of lower cystine content and lower mean amino acid availability values .

From the present results it could be recommended to use a lower processing temperature of 123°C to obtain HFM of higher amino acid availability and metabolizable energy contents .

Considering the results of protein digestibility and true metabolizable energy which, were not significantly varied among the different processed meals and those of amino acid availability which were significantly different, the dietary protein must be balanced on the basis of amino acid availability values not on the amino acid content or the protein digestibility. This is sufficiently extensive to be taken into consideration in formulating poultry rations.

References

Association of Official Analytical Chemists (1980) " Official Methods of Analysis " , 13 th ed Assoc. off. Anal . Chem. Washington , D. C.

Baker , D. H., Blitenthal , R. C., Boebel , K. P., Czarnecki , G. L, Southern , L.L. and Willis, G . M . (1981). Protein amino acid evaluation of steam processed feather meal. *poult . Sci* : **60** : 1865 .

Binkley, C. H. and **Vasak , O. R.** (1950) Production of a friable meal from feathers. Bureau of Agricultural and Industrial Chemistry. *Agricultural Research Administration, U.S.D.A., publication No . AIC.* **274** .

Block, R.J. and Mitchell , H.H. (1946) The correlation of the amino acid composition of protein with their nutritive value. *Nutr . Abstr . Rev* ., **16** : 249 .

Burgos, A., Floyd, J. I . and Stephenson , E. L. (1974) The amino acid content and availability of different samples of poultry by-product meal and feather meal. *Poult . Sci* . **53**: 198.

Davis, J. G., Mecchi , E. P., and Lineweaver , H . (1961) Processing of poultry by-products and their utilization I. Processing of poultry by-products. USDA, ARS, Utilization Research Report 3 : 1 .

El-Boushy , A. R . and Roodbeen , A. E. (1984) Amino acid availability in dry poultry waste in comparison with relevant feedstuffs . *poult sci* : **63** : 583 .

El - Sherbiny , A. E., Mohamed, M. A ., Ali , H. M. and Abou Raya, A. K. (1988) True amino acid availability of poultry slaughterhouse by-product meals , fish meal and soybean meal. J. Agric. Sci. Mansoura Univ . **13** : 694 .

Kirby, L. K., Nelson, T. S., Johnson, Z. and Waldroup , P. W. (1978) Content and digestibility by chicks of the amino acids in wheat , fish meal and animal by - products. *Nutr. Rep. Int.* 18 : 591 .

MacAlpine, R. and Payne, . G. (1977) Hydrolyzed feather protein as a source of amino acids for broilers. *Br . poult . sci* **18** : 265 .

Mohamed, M. A . (1989) Poultry slaughterhouse by-product meals as feedingstuffs. *J. Egypt. Poult . Sci.* **9** : 269 .

Mohamed, M. A., El-Sherbiny, A. E., Ali, H. M. and Abou Raya, A. K. (1988) Chemical evaluation of poultry slaughterhouse by - product meals and some other feedstuffs . *J . A gric . Sci . Mansoura Univ* . **13** : 673 .

Moore, S . (1963) On the determination of cystine as cystiec acid. *J. biol. chem.* **238** . 235.

Moran, E. T., Summers, J. D. and Slinger, S. J. (1966) Keratin as a source of protein for the growing chick. 1. Amino acid imbalance as the cause for inferior performance of feather meal and the implications of disulfide bonding in raw feathers as the reason for poor digestibility . *Poult. sci* . **45** : 1257 .

Morris, W. C. and Balloun, S. L. (1973) Evaluation of five differently processed feather meals by nitrogen retention , net protein values , xanthine dehydrogenase activity and chemical analysis. *Poult . Sci* . **52** : 1075 .

Naber, E. C. and Morgan, C. L . (1956) Feather meal and poultry meat scrap in chick starting rations. *poult . Sci* . **35** : 888.

Naber, E. C., Touchburn, S. P., Barnett, B. D. and Morgan, C. L. (1961) Effect of processing methods and amino acid supplementation on dietary utilization of feather meal protein by chicks. *poult. Sci.* **40** : 1234 .

National Research Council, NRC (1984) Nutrient Requirements of Poultry. *8th ed. Nat. Acad. Sci. Washington, D. C.*

Papadopoulos, M.C (1984) Feather meal " evaluation of the effect of processing conditions by chemical and chick assays. *Ph. D. Thesis, Agric. Univ., wageningen, The Netherland* .

Papadopoulos, M . C., (1985) Processed chicken feathers as feedstuff for poultry and swine : A review. *Agric. wastes,* 14 : 275 .

Papadopoulos, M. C., El-Boushy, A. R. and Ketlaars, E. H. (1985) Effect of different processing conditions on amino acid digestibility of feather meal determined by chicken assay. *poult. Sci.* **64** : 1729 .

Parsons, C. M., Potter, L. M. and Brown, R. D. Jr. (1982) Effect of dietary protein and intestinal microflora on excretion of amino acids in poultry. *poult. Sci.* **61**. 939 .

Sibbald, I . R. (1976) A bioassay for true metabolizable energy of feedingstuffs. *poult. Sci.* 55 303

Sibbald, I. R. (1986) " The T. M. E. system of feed Evaluation : methodolgy, feed composition data and bibliography ". *Research Branch Technical Bulletin,* 86 - 4E , *Animal Research center, Agriculture canada, ottawa, canada* .

Spackman, D. H., Stein, W. H. and Moore, S. (1958) Automatic recording apparatus for use in the chromatography of amino acids. *Analyt. chem* . 30 : 1190 .

Steel, R. G. D. and Torrie, J. H. (1980) "Principles and Procedures of Statistices" . *2nd ed. Mcgraw -Hill book Book co., INc. New York, N. Y.*

Sullivan , T . W . and Stephenson, E. L. (1957) Effect of processing methods on the utilization of hydrolyzed poultry feathers by growing chicks. *poult. sci* . 36 : 361 .

Terpstra, K. and De Hart, N . (1974) The estimation of urinary nitrogen in poultry excreta. *Zeitschrift fur Tierphysiologie, Tierernahrung und Futtermittelkunde*, 32 : 306

Wilder, O. H. (1972) Effects of processing on the quality of animal by-products with special reference to feather meal. *Proc . Md . Nutr . conf .*, 83 .

تأثير ظروف التصنيع على القيمة الغذائية لمسحوق الريش

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تم فى هذه الدراسة تعريض الريش الى ظروف تصنيع مختلفة من حيث الضغط ، درجة الحرارة وزمن التصنيع ، واوضحت النتائج أن درجات الحرارة المرتفعة تؤدى الى زيادة طفيفة فى نسبة البروتين الخام وكذا الطاقة الكلية فى المسحوق الناتج كما أنها تؤدى الى انخفاض محتوى الريش من الحمض الامينى سستين .

وقد وجد أن مسحوق الريش يحتوى على مستويات عالية من أغلب الاحماض الامينية الضرورية لكنه تغير فى محتواه من الاحماض الامينية ميثيونين ، ليسين ، هستيدين التى تمثل الاحماض الامينية المحددة الاول والثانى والثالث على التوالى . عند تقدير معامل الهضم الحقيقى لبروتين الريش وجد أنه يتراوح بين ٧٩ ، ٥ ر٨٢٪ ولم يتأثر معنويا باختلاف ظروف التصنيع وكذلك قيمة الطاقة الممثلة الحقيقية .

كانت الحرارة هى العامل الاكثر تاثيرا على معامل الاستفادة من الاحماض الامينية حيث أدت الحرارة المرتفعة الى انخفاض معامل الاستفادة وكانت الاحماض الامينية سستين ، ميثيونين ، ليسين وهستيدين من أكثر الاحماض تاثرا بدرجة الحرارة وطول فترة التصنيع.