Effect of added amino acids manufactured from poultry slaughterhouse waste by subcritical water on the productive performance of Chinese geese

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Abstract

This study was conducted at the waterfowl field, Animal Production Department, Agriculture College, University of Basrah, from 7/2/2020 to 17/4/2021, to study the effect of adding amino acids manufactured from poultry slaughterhouse waste using subcritical water, assisted by Jolly heating in the productive performance of Chinese geese. A total of 90birds were used in the study, reared to 20 weeks of age. Birds were randomly distributed to three treatments for each treatment, 3 replicates, (10 birds each replicate). *add libitum* feeding, some productive and economic traits have been studied. The results indicated the superiority of the second treatment T2 (a diet containing productive amino acids while reducing the proportion of soybean meal to 15%) on the average live body weight, weight gain rate and production index at all ages except from 12-14 weeks compared to the control treatment, while the same treatment showed a significant decrease on the amount of feed intake and feed conversion efficiency compared to the other of the treatments except week 16 and 12 in the amount of feed consumed and feed conversion efficiency, respectively. We conclude that the use of amino acids manufactured from critical water coupled with Jolly heating gave good results compared to imported amino acids.

keywords: amino acids manufactured, subcritical water, Chinese geese.

Introduction

Nowadays, the world is facing a major problem, represented by the lack of protein in food and nutrition for the purpose of filling this deficiency. The attention of scientists and researchers has turned to the use of new sources to obtain amino acids, such as bone proteins, feathers, single-celled proteins, whey proteins and poultry slaughterhouse waste (Ojha, *et al*., 2020).

The addition of protein concentrates to the diet for recommended by manufacturers will provide the feed with good quality protein, at the same time, it fills the poultry needs of vitamins and minerals, in addition to providing essential amino acids such as methionine and lysine and minerals such as calcium and phosphorous (Olarotimi, 2017; Alam *et al*., 2015), to provide poultry waste in large quantities and not to use, it has become an environmental problem, it must be taken into account, they contribute greatly to pollution, which leads to major problems (Al-Tai, 2005).

Some studies have focused on the manufacture of a protein center from poultry waste, modern technologies were used to transform poultry waste, to useful materials in feeding and birds, preserving the environment from the accumulation of these substances and their impact on public health (Dong *et al*., 2019). The researchers resorted to using several methods, including the base and the acid, this method was characterized by short decomposition time, cheapness and ease, this method causes damage to many essential amino acids, including methionine and tryptophan and an increase in the proportion of salts as a result of the pH adjustment. Another method used is enzymatic hydrolysis to improve protein properties, because it gives the product good functional properties and high nutritional value (Saleh *et al*., 2020).

Subcritical water (SCW) is considered an environmentally friendly process (Zhan *et al*., 2020). Subcritical hydrolysis offers several advantages, including avoiding toxic chemicals, the reaction time is short, the abrasion is minimal, low residue generation and byproduct generation. Subcritical water is defined as liquid water in the boiling point temperature range to or near the critical point (100-374 °C) (Prado *et al*., 2014). Proteins are one of the most hydrolyzed biopolymers by subcritical water technology, which can be liberated from the protein mass into valuable peptides and free amino acids, can be easily extracted by conventional techniques such as ultrafiltration or spray drying, from an environmental point of view, leads the recovery of valuable compounds (such as peptides and amino acids), from food waste to creating more sustainable and environmentally friendly processes as long as the amount of waste is reduced. Moreover, protein retrieval helps to increase the utilization of natural resources used as raw materials in the food industry (Marcet *et al*., 2016).

The study aims to add amino acids manufactured from poultry slaughterhouse waste by subcritical water combined with Jolly heating, and its effect on the productive performance of Chinese geese.

Materials and Methods

Protein concentrate Preparation:

Poultry waste was washed with water, then it was cooked at 140°C for 50 minutes according to the method of Wiradimadja *et al*. (2014). Then the resulting fat layer was removed from it, chopped with a Kenwood PG520 Electric Meat Chopper, made in China, with holes 4 mm in diameter. Then the product was dried in an oven dryer model 09.14375 from the German-made Binder company at 60°C for 12 hours until it dried and then the resulting material was ground.

Amino acid recovery:

A locally manufactured amino acid retrieval device was used in the Food Laboratories Engineering Laboratory at the College of Agriculture, University of Basrah. It consists of a Teflon recovery cylinder with an internal volume of 165.05 cm^3. The cylinder contains two poles made of stainless steel (28*5) cm, they were used for jolly heating. The cylinder is fitted with a cap. CO_2 cylinder is used to inject gas into the recovery cylinder. There was a heat exchanger used to cool the output product. The system also contains an opening for the exit of the generated gases. The recovery process takes place after placing 3 liters of a mixture of water and protein concentrate (2 water: 1 protein concentrate), after filling, CO_2 gas was pumped and the device is turned on, with the setting of voltages and time. Then the product was exited through the heat exchanger to a container for collection, then store at 5 °C for HPLC analysis, each sample was repeated three times.

Studying the effect of added the extracted amino acids to the diet on the productive performance of Chinese geese:

Poultry slaughterhouse residues were taken (feathers, heads and legs, internal entrails were not eaten), then the amino acids are extracted by using subcritical water coupled with joule heating, a comparison of the best results between the aforementioned waste, after performing the analysis using the HPLC device. This study was conducted at the waterfowl field of the Animal Production Department, the College of Agriculture, University of Basrah, from 7/2/2020 to 17/4/2021, to study the effect of adding amino acids manufactured from poultry slaughterhouse waste by subcritical water combined with jolly heating in the productive performance of Chinese geese. A total of 90 birds were used in the study, reared to 20 weeks of age. Birds were randomly distributed to three treatments for each treatment, 3 replicates (10 birds for each replicate) , it was fed on a free diet as follows:

1. **Control treatment T0** (Basal diet) (a diet containing imported amino acids with 25% soybean meal).
2. **The first treatment T1** (a diet containing manufactured amino acids with reducing soybean meal to 20%).
3. **The second treatment T2** (a diet containing manufactured amino acids with reducing soybean meal to 15%).

As amino acids were added to the feed as shown in Table (1).

Table (1) The diet used in the study (%).

Items	Control treatment T0	The first treatment T1	The second treatment T2
Maize	45	45	45
Wheat	18.5	18.5	18.5
Wheat bran	5.0	5.0	5.0
Soybean meal (44%)	25	20	15
Beans	0.69	5.5	11
Vegetable oil	2.20	2.3	2.0
Limestone	1.50	1.50	1.60
Dicalcium Phosphate	0.90	0.90	0.50
Premix*	0.44	0.50	0.50
DL-Methionine*	0.216	0.0	0.0
L-Lysine *	0.254	0.0	0.0
Manufactured added Methionine**	0.0	0.236	0.146

Manufactured added lysine**	0.0	0.254	0.362
Salt	0.30	0.31	0.40
Total	100	100	100
Chemical Analysis***			
Metabolize energy (kilocalories / kg)	2930	2935	2933
Crude protein (%)	18.37	17.41	16.63
Calcium (%)	0.86	0.82	0.84
Available Phosphorus (%)	0.46	0.46	0.35
Methionine (%)	0.50	0.50	0.50
Lysine (%)	1.15	1.10	1.14

* Imported amino acid

** Manufactured amino acid local factory

***According to the chemical composition according to the analyzes of the feed materials contained in the NRC (1994)

The productive characteristics were studied, including:

1. live body weight (g):

Birds were weighed at the beginning of the experiment at 10 weeks of age individually for each replicate, then they were individually weighed weekly until the end of the experiment at 20 weeks of age, by a sensitive scale according to the following equation:

$$\text{Live body weight (g)} = \frac{\text{Total weight of live birds at end of the week}}{\text{Number of birds at the end of the week}}$$

(Al-Mhsenawi *et al*., 2021).

2. Weight gain (g):

The average weight gain of birds was calculated during the breeding periods (10-12), (12-14), (14-16), (16-18), (18-20) weeks according to Al-Mhsenawi *et al*. (2021):

Weight gain (g) = live body weight at the end of the period - body weight at the beginning of the period.

3. feed intake (g):

The feed intake weekly was calculated by the difference between the amount of feed provided to the birds and the remaining feed (Al-Mhsenawi *et al*., 2021) according to the following equation:

Feed intake (g/bird) = (Feed provided to birds at the beginning of the period) -(Feed remaining at the end of the same period).

4. Feed Conversion Factor:

The feed conversion factor for birds was calculated weekly according to the following equation (Mareb *et al*., 2019).

$$\text{Feed conversion factor} = \frac{\text{Feed intake}}{\text{Weight gain}}$$

5. The Production index:

The value of the Production index was calculated according to the equation referred to (Al-Mhsenawi *et al*., 2021).

$$Production\,index = \frac{\text{Body weight} \times Viability}{Periods\ (day) \times Feedconversion \times 10}$$

viability = 100 - mortality

5. Mortality:

No mortality were recorded during the experiment period.

Statistical analysis:

A Complete Randomized Design (CRD) were used, to study the effect of different treatments on the studied traits, the results were analyzed using the statistical program (SPSS, 2017).

Results

Table (2) shows the effect of added manufactured amino acids from poultry slaughterhouse waste by subcritical water coupled with jolly heating on live body weight (g) of Chinese geese at different ages. It was a significant effect (P≤0.05) of amino acids on the average live body weight, T2 showed a significant superiority compare to the other of the treatments, the weight of the live body at the age of 20 weeks was (5450) g compared to the control treatment, which amounted to (4925) g. The table also showed a significant effect of age on living body weight rates, T2 was significantly superior (P≤0.05) compare to the control treatment at all ages, where the average body weight at 12 and 18 weeks of age was 2491 and 4950 g, respectively, while the control treatment amounted to 2900 and 4500 g, respectively.

Table (2) Effect of manufactured amino acids from poultry slaughterhouse waste by subcritical water coupled with jolly heating on live body weight (g) of Chinese geese.

Treatments	Age (weeks)					
	10	**12**	**14**	**16**	**18**	**20**
T0	2300 [a] ±80.12	2900[c]± 57.34	3550 [c] ±16.13	4050 [c] ±36.84	4500 [c] ±60.78	4925 [c] ±50.91
T1	2368[a]±158.12	3050[b]±60.11	3690 [b] ±33.20	4233 [b] ±57.45	4775 [b] ±28.34	5300 [b] ±33.13
T2	2491 [a]	3150 [a]	3816 [a]	4433 [a]	4950 [a]	5450 [a]

	±28.14a	±83.61	±44.23	±22.11	±27.25	±60.51
P Value	NS	**	**	**	**	**

Table (3) shows the effect of added manufactured amino acids from poultry slaughterhouse waste by subcritical water coupled with jolly heating on the rate of weight gain (g/day) of Chinese geese at different ages. There was a significant effect (P≤0.05) of processed amino acids on the daily weight gain, T2 showed a significant superiority compare with the other of the treatments, the average cumulative weight gain of (10-20) weeks was (42.27) g/day compared to the control treatment, which amounted to (37.50) g/day.

The table also showed that there was a significant effect (P≤0.05) of age on the rates of weight gain, as T2 was significantly superior (P≤0.05) compare to the control treatment at all ages, where the average weight gain at the age of (10-12) and (18-20) weeks (47.07 and 35.71) g/day, respectively, while the control treatment amounted to (42.85 and 30.35) g/day, respectively. While there were no significant differences at the age of (12-14) weeks.

Table (3) Effect of manufactured amino acids from poultry slaughterhouse waste by subcritical water coupled with jolly heating on the rate of weight gain (g/day)of Chinese geese.

Treatments	**Age (weeks)**						**cumulative weight gain**
	10	**12**	**14**	**16**	**18**	**20**	
T0	35.71[c] ±3.86	46.42 [a]±1.66	35.71 [c]±1.16	32.14[b]± 2.11	30.35 [c]±1.21	37.50 [c] ±1.25	35.71[c]±3.86
T1	48.71[a] ±4.09	45.71 [a]±3.30	38.78 [b]±2.73	1.8±a 38.17	37.50 [a]±2.21	41.88 [b] ±2.10	48.71[a]±4.09
T2	47.07[a] ±4.39	47.57 [a]±4.09	44.07 [a]±1.42	36.92 [a]±2.50	35.71 [a]±1.30	42.27 [a] ±2.30	47.07[a]±4.39
P Value	**	NS	*	*	*	*	**

Table (4) shows the effect of added manufactured amino acids from poultry slaughterhouse waste by subcritical water coupled with jolly heating in the average amount of feed intake (g/day) for Chinese geese at different ages, there was a significant effect (P≤0.05) of processed amino acids on the average daily consumed feed quantity, T2 showed a significant decrease (P≤0.05) compare the other treatments, the cumulative rate of feed consumed was (222.19) g/day/fowl, compared to the control treatment, which amounted to (236.40) g/day/bird. The table also showed a significant effect of age on the average daily intake feed, T2 showed a significant decrease (P≤0.05) compared to the control treatment at all ages, where the average weight gain at 12 and 20 weeks of age was (200.00 and 246.33) g/day/bird, respectively, while the control treatment reached (212.00 and 261.67) g/day/day, respectively, there were no significant differences between treatments at 16 weeks of age.

Table (4) Effect of manufactured amino acids from poultry slaughterhouse waste by subcritical water coupled with jolly heating on the rate of weight gain (g/day)of Chinese geese.

Treatments	Age (weeks)					Cumulative feed intake
	12	14	16	18	20	
T0	212.00 ±4.24a	224.00 2.00 ±a	230 00. 4.41 ±a	255 ± 00. 3.32a	261.67 ± 1.70a	± 236.40 a 2.58
T1	206.00 3.68 ±b	219.00 b ± 3.30	225 00. 2.14 ±b	236.28 ± 2.78b	250.00 ± 3.22b	227.25 ± 3.66b
T2	200.00 4.41 ± c	217.00 b ± 2.38	223 00. 4.00 ± b	234.64 ± 4.68b	236.33 ± 2.62c	222.19 ± 2.30c
P Value	*	*	NS	*	*	*

Table (5) show the effect of added amino acids manufactured from poultry slaughterhouse waste by subcritical water coupled with jolly heating on average the feed conversion efficiency of Chinese geese at different ages, there was a significant effect (P≤0.05) of processed amino acids on the cumulative feed conversion efficiency rate, T2 showed a significant decrease compared to the control treatment, which did not differ significantly from T1 as the feed conversion efficiency rate compare with T2 (5.25) compared to the control treatment (6.54). The table also showed that there was a significant effect of age on the rate of feed conversion efficiency, T2 showed a significant decrease (P≤0.05) compared to the control treatment and at all ages, where the rate of feed conversion efficiency at 16 and 20 weeks of age reached (5.05 and 6.61), respectively, while it was in the control treatment (6.44 and 8.62), respectively. There were no significant differences between treatments at 12 and 14 weeks of age.

Table (5) Effect of manufactured amino acids from poultry slaughterhouse waste by subcritical water coupled with jolly heating on average the feed conversion efficiency (g/day)of Chinese geese.

Treatments	Age (weeks)					Cumulative feed conversion
	12	14	16	18	20	
T0	4.94±0.40	4.82±o.25	6.44 ^{a}±o.35	7.93 ^{a}±o.92	8.62 ^{a}±o.88	6.54^{a}±o.75
T1	4.22±0.75	4.79 ±o.20	5.80^{b}±o.50	6.10 ^{b}±o.45	6.66 ^{b}±o.91	5.43^{b}±o.15
T2	4.24±0.	4.56	5.05^{c}±o	6.35	6.61	5.25^{b}±o.5

	70	±o.17	.45	^{b}±o.70	^{b}±o.66	0
P Value	NS	NS	*	*	*	*

Table (6) show the effect of amino acids manufactured from poultry slaughterhouse waste by subcritical water coupled with jolly heating in the production index of Chinese geese. The results indicate a rise in the production index standards in Chinese geese, the high values of these standards are a clear indication of the good performance of Chinese geese, as good performance is the one that achieves the highest marketing weight in the shortest period of time and with good food conversion efficiency, and thus this indicates a good economic.

Table (6) Effect of manufactured amino acids from poultry slaughterhouse waste by subcritical water coupled with jolly heating on the production index of Chinese geese.

Treatments	Production index
T0	408.10
T1	568.42
T2	588.93

Discussion

The productive traits (body weight, weight gain rate and quantity of feed intake) were among the most important traits in bird breeding projects, usually the goal of the breeder is to achieve the highest weight gain in the living body and the lowest rate of feed consumption within a short period of time, the reason may be that the second treatment was superior to the control treatment in body weight and the amount of weight gain, to the effect of manufactured amino acids from poultry slaughterhouse waste by subcritical water combined with jolly heating, which was based on the hydrolyzing of food. It was a unique method to increase the amount of by-product and reduce losses (Espinoza, 2011). The body's needs for crude protein are based on the protein content, digestion and absorption of amino acids, because the molecules of the body were built and destroyed, they are constantly renewed, providing the body with amino acids in sufficient quantities is extremely important to support growth and improve the economic characteristics of birds (Mohamed *et al*., 2018).

Ahmed (2018) by his study showed that the use of massacre residues powder at rates of 0, 5, 10 and 15%, the results showed that the birds treated with a concentration of 15% were significantly superior compare to the control treatment in increasing the average body weight, weight gain, and decreasing the amount of feed consumed and the efficiency of feed conversion, it may also be due to the superiority of treatments to which manufactured amino acids from poultry slaughterhouse waste were added by subcritical water combined with jolly heating compared to the control treatment, to the quality and efficiency of manufactured amino acids compared to imported amino acids, as the manufacturing conditions such as heat and pressure lead to the appearance of slaughterhouse waste powders of varying nutritional value (Sahrai, 2012).

According to Elwy (2020) the level of protein and essential amino acids affect the amount of feed intake and the efficiency of food conversion, the lack of protein and amino acids reduces the growth rate and increases the amount of feed intake by the bird. Geese fed on high-protein diets have better average body weight and feed conversion efficiency. The addition of protein and amino acids, especially the amino acid methionine, which is an essential amino acid and the first amino acid in poultry feed, the body of a geese cannot synthesize it, amino acids were essential to meet the physiological and nutritional requirements for the maintenance and growth of the pre-mature body and feathers of geese. The improvement in body weight and feed conversion efficiency of geese in this study may be due to higher plasma insulin growth factor (IGF-I) concentrations, which consists of a higher protein content (23%) that has higher plasma concentrations (IGF-I) compared to those fed nutritional levels of 19% or 17, respectively.

In a study on ducks, Yongbao *et al*. (2021) found that methionine is a determinant of poultry growth, it was noted that the growth rate decreases and the amount of feed intake when the diet is reduced with the amino acid methionine, if the values of these criteria are above 250, this indicates that education is good and efficient, as for the decrease, it indicates the opposite (Al-Muzani and Al-Asadi, 2021).

The reason for the improvement in the productivity index scale may be due to the superiority of the third treatment in the average body weight, weight gain and food conversion factor, as a result of the bird getting its needs of essential amino acids, especially methionine and lysine (Vitale *et al*., 2010).

Conclusions

We conclude that the use of locally manufactured amino acids from subcritical water coupled with jolly heating gave good results compared to imported amino acids.

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