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NUTRITIVE VALUE OF THE AMARANTH SEED CALYX AS TESTED IN GROWING CHICKENS*

Three material fractions are obtained from the flower head or inflorescence during amaranth seed harvesting. These are: the seed, which represents around 24o/o of the flower head weight; the inflorescence without seeds, which on the average represents 75o/o of the initial weight, and the seed calyx, which represents only 1o/o of the inflorescence weight. Although variability in inflorescence weight is relatively high, the average weight of *A. cruentus* GUA 17 inflorescence is 420 g fresh weight. On the basis of 180,000 plants per hectare, the potential yield of the calyx will therefore be around 760 kg/ha. Even though comparatively small with respect to the inflorescence residue and the seed, the calyx physical fraction merits some attention. Physically, this fraction looks very much like wheat bran, although its particles are smaller in area and of a darker color. The purpose of this study, therefore, was to learn more about the possibility of utilizing the residues or by-products of amaranth seed harvesting, and in the case of this report, to study the chemical composition and nutritive value of the calyx.

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Materials and Methods

The physical fraction, or calyx, utilized in this study was obtained during the harvesting of amaranth seed from selection *A. cruentus*, GUA 17. A representative sample was taken for proximate chemical analysis which was carried out using ADAC methodology (1). The material was then added to a corn/extruded whole soybean basal diet to replace an equal weight of wheat bran, so as to give 0, 4, 8 and 12o/o levels. The ingredient composition of the diets is shown in Table 1. An additional group with 12o/o was also included, but the calyx was steam-treated for 15 minutes and then dried with hot air. Since in other studies with the whole young green biomass of amaranth, it was found that a steam treatment

improved its nutritive quality (2), it was assumed that the same effect would be obtained with the calyx fraction.

The diets were offered *ad libitum* to 30 one-day-old baby chicks, per group, with 3 replications of 10 chicks each, for a total period of 56 days. Each group of 10 chicks was placed in temperature-controlled battery brooders for 4 weeks, and then transferred to ground pens for an additional 4 weeks. Water was available at all times and weight changes and feed consumed were measured every 7 days. The results were statistically analyzed by analysis of variance (3).

Results and Discussion

The chemical composition of the calyx physical fraction compared to that of wheat bran, is shown in Table 2. As results indicate, the amaranth seed calyx contains more crude fiber and ash than wheat bran, and has a lower crude protein content. The high crude fiber content suggests that it may be a limiting factor for animals not able to utilize high fiber levels; however, the protein content is comparable to that in maize and sorghum. The high ash content should be examined further in future studies. It is also of interest to collect more data on the variability in chemical composition of the amaranth seed calyx fraction.

Table 3 depicts the chick performance data. These include average weight gain, feed intake and feed efficiency. As findings indicate, the best performance in weight gain and feed efficiency took place with the diet containing 4% amaranth seed calyx, but at the 8% level there was no great difference. Weekly records showed that the 4% group was always better than any other group; however, it was during the last 3 weeks of the 8-week study that differences between this group and the other became larger. It is also of interest to point out that although the 12% wheat bran (Diet 1) provided 1.3% crude fiber as compared to the 12% amaranth seed calyx (Diet 4) which provided 3.6% crude fiber, the latter gave a better chick performance, suggesting that crude fiber in the diet was not affecting chick performance. In future studies, therefore, it would be of interest to characterize the crude fiber of amaranth seed calyx, since it may be useful as a source of dietary fiber for human consumption as wheat bran is used today, increasing the economic potential of amaranth seed production. It is also worthwhile to point out that a steam treatment applied to the amaranth seed calyx induced changes in its acceptability by chicks not reflected in feed efficiency but on weight gain and feed intake, which would reflect changes in nutritive value. This finding is similar to that previously reported for the steam treatment of the young plant used as a feed for rabbits (2). This simple process would be a way to attempt the use of this physical fraction as a dietary fiber source in human nutrition.

The data presented indicate, therefore, that this physical fraction derived from amaranth seed harvesting can have useful applications in animal feeding and possibly in human foods, thus increasing the economic potential of amaranth.

Table 2. Proximate chemical composition of wheat bran and amaranth seed calyx (%)

	Amaranth seed calyx	Wheat bran
Moisture	14.4	13.6
Ether extract	3.1	5.0
Crude fiber	30.2	10.9
Protein (N x 6.25)	11.9	15.5
Ash	10.2	5.3

Table 3. Chick growth performance

Level of A. S. calyx in diet, %	Ave. wt. gain, g*	Ave. feed intake, g	Feed efficiency**
0	1763 ± 192.2	4786	2.64
4	2038 ± 223.2	4865	2.33
8	1962 ± 364.0	4734	2.36
12	1853 ± 191.4	4664	2.40
12***	1931 ± 181.9	5220	2.61

* Ave. initial wt: 47 g.
** Total food consumed/total final weight.
*** Steam treated.

Table 1. Ingredient composition of poultry diets (%)

Ingredients	Diet No.				
	1	2	3	4	5
Yellow corn meal	46.00	46.00	46.00	46.00	46.00
Whole soybean meal*	38.00	38.00	38.00	38.00	38.00
Wheat bran	12.00	8.00	4.00	—	—
Amaranth seed calyx	—	4.00	8.00	12.00	12.00**
DL-methionine	0.15	0.15	0.15	0.15	0.15
Bone meal	2.00	2.00	2.00	2.00	2.00
Calcium carbonate	1.30	1.30	1.30	1.30	1.30
Iodized salt	0.30	0.30	0.30	0.30	0.30
Vit/min Premix	0.25	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00	100.00

* Extruded with the Brady Extruder.
** Steam-treated for 15 min and dried.

Bibliography

1. Association of Official Agricultural Chemists. *Official Methods of Analysis of the AOAC.* 12th ed. Washington, D. C., The Association, 1975.

2. Alfaro, M. A., R. Ramírez, A. Martínez & R. Bressani. Evaluación de diferentes niveles de harina de amaranto (partes vegetativas) en sustitución de harina de alfalfa para conejos en crecimiento. *Arch. Latinoamer. Nutr.* (Accepted for publication).

3. Snedecor, G. W. *Statistical Analysis.* Ames, Iowa, The Iowa State Press, 1948.

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BOSTID RESEARCH GRANTS PROGRAM GRAIN AMARANTH COORDINATION MEETING, CUZCO, PERU

Tuesday, April 29

Opening Ceremony. Keynote. Eng. Luis Sumar Kalinowski.

Production, Agronomic Practices, Harvest Storage

R. Bressani, Chairman; Suthat Julsrigival (Thailand); Soonthorn Duriaprapan (Thailand); Luis Sumar (Peru); Gladys Semenas (Venezuela)*; C. S. Kauffman (USA); Discussion; P. Kulakow, Rapporteur.

Breeding, Selection, Germ Plasm Collection

Suthat Julsrigival, Chairman; V. Gupta (Kenya); P. Kulakow (USA); Discussion; R. Becker, Rapporteur.

Wednesday, April 30

Processing, Food Products, Nutrition

V. Gupta, Chairman; R. Bressani (INCAP, Guatemala); A. Sánchez-Marroquín (Mexico); E. Morales (Peru); R. Becker (USA); Discussion; C. Kauffman, Rapporteur.

Marketing, Dissemination of Information

A. Sánchez-Marroquín, Chairman; G. Scott (CIP, Peru); R. Bressani (INCAP, Guatemala - *Amaranth Newsletter);* Discussion; M. Greene, Rapporteur.

Thursday, May 1 and Friday, May 2

Field Trips

Friday May 2

Conclusions and Recommendations. Reports on Discussion Topics.

Other Presentations

1. Dr. Daniel K. Early*

* Not BOSTID grantees.