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EFFECT OF GAMMA IRRADIATION AND AUTOCLAVING TREATMENT ON THE NUTRITIVE VALUE OF GUAR MEAL

A. R. Barque,* A. Sattar,** M. Rafique Ch., M. Z. Alam and M. J. Qureshi

Nutritive value of guar meal as affected by gamma irradiation (1-5 Mrad) and autoclaving treatment (121 °C, 1h) was assessed through chick growth assay. Test material incorporated at 10% level in the rations was fed *ad. libitum* to broiler chicks for nine weeks, which provided 21% of the total ration protein (21.10%). Gamma irradiation significantly improved the feed efficiency ($P<.05$), chick growth ($P<.01$) and cost economics of the ration ($P<.05$), in comparison to the conventional autoclaving treatment. These treatments also showed a marked differential effect on the dressing percentage of chicks.

INTRODUCTION

Pakistan like most of the developing countries is facing the problem of protein malnutrition. Poultry industry of the country, as it stands today, can play an important role in solving this problem, provided its yielding potential is utilized to the maximum. The dynamic progress of this enterprise is being hindered by short supply of protein furnishing feed ingredients which could be used to formulate efficient as well as economical rations. Exploration of cheap and potential sources of proteins, therefore, deserves first priority among other problems facing poultry industry of this country.

Guar meal, a by-product of gum industry, is comparatively a cheap and potential source of protein (Ramakrishnan, 1967). However, certain antinutritional factors have been reported to affect the feeding value of guar meal (Malik and Sheikh, 1967). The detoxification of guar seeds by thermal treatments met with a little success, while bean and casein proteins were nutritionally deteriorated (Robert and Bauer, 1978).

Gamma irradiation has been successfully employed for improving the nutritional and textural qualities of broad beans and field beans (Reddy *et al.*,

* Department of Nutrition, University of Agriculture, Faisalabad.

** Nuclear Institute for Agriculture and Biology, P. O. Box 128, Faisalabad.

1979) and in case of rice and beans, physico-chemical alterations in carbohydrate and protein constituents have been attributed to the depolymerization of such macromolecules (Chaudhry and Glew, 1973 and Scherz, 1974).

The present study was undertaken to assess the effectiveness of gamma irradiation in improving the nutritive value of guar meal in comparison to the conventional autoclaving treatment.

MATERIAL AND METHODS

Rations : Five lots, each of 15 kg guar meal, were individually subjected to 1, 2, 3, 4 and 5 Mrad dose of gamma irradiation (Gamma Cell 220, Atomic Energy Canada Ltd, installed at the Nuclear Institute for Agriculture and Biology (NIAB), Faisalabad) and added to experimental rations R_1, R_2, R_3, R_4, R_5, respectively, while one 14 kg lot of guar meal was autoclaved for 1h under a steam pressure of 15 lb p. s. i. and incorporated in the control ration R_0. Percent-

Table 1. *Percentage composition of experimental ration.*

Ingredients	Percentage	Ingredients	Percentage
Maize	35.0	Corn gluten meal (60%)	6.0
Rice broken	10.0	Blood meal	6.0
Rice polishing	15.0	Fish meal	5.0
Wheat bran	8.0	Molasses	2.5
Guar meal	10.0	Lime stone	2.0
Vit. & min. premix	0.5		

Table 2. *Biological composition of the experimental rations**

Crude protein (%)	= 21.19	Crude fibre (%)	= 3.3
M. E. (Kcal/kg)	= 2919.80	Calcium (%)	= 1.28
Phosphorus (%)	= 1.1	Protein : Energy	= 1:138
Calcium : Phosphorus	= 1.3 : 1.1		

* R_1 — Guar meal irradiated at one Mrad dose, gamma radiation.
R_2 — Guar meal irradiated at two Mrad dose, gamma radiation.
R_3 — Guar meal irradiated at three Mrad dose, gamma radiation.
R_4 — Guar meal irradiated at four Mrad dose, gamma radiation.
R_5 — Guar meal irradiated at five Mrad dose, gamma radiation.

age formulation and biochemical composition of all the six rations are given in Table 1 and 2. The rations were analysed for crude proteins, crude fibre, metabolizable energy, calcium, phosphorus according to the methods of AOAC, 1975.

Chicks : One hundred and eighty, day-old Indian River Hybrid broiler chicks were used as test birds. These were wing banded for identification. All the birds were individually weighed at the start of the experiment and randomly divided into 18 groups, comprising 10 chicks each. Rearing of the birds was done in a small experimental room, partitioned into 18 pens of $4' \times 3' \times 2.5'$ dimensions each. Each pen was covered with a wire gauze to avoid the steal-stepping by the chicks. Electric bulbs and fans were used to maintain the room temperature within the permissible range, 95 : 5—75 · 5 F.

Feeding procedure :

The chicks were randomly assigned to the six experimental rations in such a way that there were three groups of birds under each ration. The rations and fresh water were fed *ad. libitum* to chicks for nine weeks. The daily feed offered to each replicate was recorded and the refusal was weighed at the end of each week. Weekly weight gain per replicate was also recorded by weighing the chicks individually. At the termination of the feeding period, three birds from each group were slaughtered to record the slaughter data pertaining to the weights of the various organs viz; heart, liver, kidneys gizzard and adrenal glands and length of keel and shank and dressing percentage.

This experiment was planned according to the complete randomized design. The data were tabulated and subjected to statistical analysis using the analysis of variance technique. Duncan's multiple range test was applied for the comparison of mean difference (Steel and Torrie, 1980).

RESULTS AND DISCUSSION

The data regarding the total weight gain, feed consumption, efficiency of feed utilization, dressing percentage exhibited by the chicks and cost economics of the experimental rations are presented in Table 3. The results indicated that chicks fed rations containing irradiated guar meal, showed significantly

Table 3. *Performance of broiler chicks on various experimental rations*

Ration	Initial weight (kg)	Final weight (kg)	Weight gain (W) (kg)	Feed consumed (F) (kg)	Feed efficiency (F/W)	Dressing percentage	Net profit per chick (Rs)
R_0	0.047*	1.550[a]	1.503[a]	4.050[a]	2.69[a]	55.06[a]	4.45[a]
R_1	0.045	1.679[b]	1.634[b]	4.145[a]	2.54[b]	51.79[d]	5.56[bc]
R_2	0.046	1.613[ab]	1.567[ab]	3.875[a]	2.47[b]	55.54[ab]	5.17[ab]
R_3	0.045	1.662[ab]	1.617[ab]	3.950[a]	2.44[b]	56.25[b]	5.51[bc]
R_4	0.050	1.754[c]	1.704[c]	4.129[a]	2.43[b]	58.16[c]	6.01[c]
R_5	0.039	1.666[bc]	1.627[bc]	4.029[a]	2.48[b]	58.31[c]	5.15[ab]

*Values having different superscripts are significant ($P<.01$, $<.05$).

($P<.05$) better performance in their growth and efficiency of feed utilization, in comparison to those fed the ration containing autoclaved guar meal. Total feed consumption by chicks kept under different experimental rations did not vary significantly. As chick eats basically to meet its energy needs, the isocalorie potential of all the rations maintained by their uniform compositional formulation may be the possible reason for the insignificant differences in feed consumption. A significant ($P<.05$) improvement in feed efficiency was observed in rations R_1, R_2, R_3, R_4 and R_5, in comparison to the control ration, R_0. The significant difference in efficiency of feed utilization of rations R_1, R_2, R_3, R_4 and R_5 and R_0 can be explained on the basis of enhancement in availability of amino acids as a result of irradiation induced depolymerization of guar proteins to smaller molecular entities (Nene *et al.*, 1975) or an increase in nitrogen retention and decrease in uric acid nitrogen excretion in chicks (Reddy *et al.*, 1979).

Nutritional deterioration of the control ration can be due to the reduction in availability of certain amino acids, which may form a complex with carbohydrates at elevated temperatures, as observed in the earlier studies (Robert and Bauer, 1978; Damaty and Hudson, 1979).

Maximum weight gain by the chicks was recorded with ration R_4, followed by R_5, R_1, R_2, R_3, and R_0 (Table 3). A significant ($P<.01$) difference in weight gain by the chicks given rations R_4, R_5 and R_0 may be due to the difference in feed efficiency values of these rations. More difference in weight gain by chicks on rations R_4 and R_2 may be accounted for by the difference in feed consumption ($R_4 > R_2$). Weight gain by the chicks fed rations R_1, R_2 and R_3 varied insignificantly and followed the pattern of their feed consumption ($R_1 > R_3 > R_2$). Insignificant difference in weight gain by the chicks under rations R_3, R_2 and R_0, indicated that irradiation of guar meal had really improved the feed efficiency of rations R_3 and R_2, since these were consumed in smaller quantities and also led to higher weight gain in chicks than did the corresponding amounts of R_0.

It may also be concluded that both the treatments showed a marked differential effect on the dressing percentage, which followed the pattern of chick growth as influenced by different rations. The highest dressing percentage recorded with chicks raised on rations R_4 and R_5 may be due to their vigorous

and proportionate growth, aided by the balancing of ration proteins under the influence of a radiation induced structural modifications in guar proteins (Nene *et al.*, 1975).

It is evident from Table 3 that ration R_3 proved to be the most economical one, as maximum profit per chick was achieved with this ration, though operational feed cost increased as a function of irradiation dose in rations R_4-R_5. As the difference in profits with rations R_1 and R_4 or R_5 was non-significant and the efficiency of feed utilization of these rations was also the same, it seemed unwise to use higher doses of gamma irradiation, making them unprofitable. The proposed study, therefore, suggests that 1 Mrad dose is enough to overcome the antinutritional factors of macromolecular structures found in various legumes. Even lower doses of gamma irradiation may prove useful for improving the nutritive value of feedstuff with their chemistry analogous to guar meal.

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