

BUCKWHEAT AS A SUPPLEMENT TO ALL-VEGETABLE PROTEIN DIETS

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Successful all-vegetable rations for poultry feeding employing locally available feedstuffs have been previously developed for use in Central America (6, 7). With this experience and other studies of the value of plants which grow well in the area, INCAP Mixture 8 (V M 8) a vegetable mixture for human consumption has been developed from local foods and tested (1, 5). This formula has been shown to be effective for the treatment, and suitable for the prevention, of a form of severe protein malnutrition in children known as kwashiorkor which is common in Central America as in many other technically underdeveloped areas of the world.

In order to improve the commercial practicability of this V M 8 formula for human feeding and also to give greater flexibility to the formulation of poultry rations from locally grown plants, the use of buckwheat (*Fagopyrum esculentum*) as a source of carbohydrates and quality protein in such mixtures has been explored. Buckwheat is of particular interest since it is easily cultivated and yields well in the area and has been shown to have a relatively high nutritive value (9).

MATERIAL AND METHODS

Buckwheat (*Fagopyrum esculentum*) is reported to contain 11.2% of protein, 2.4% fat, 64.0% carbohydrates, 10.7% crude fiber, 1.7% ash and to have a lysine content of 0.689% (2, 3). The sample selected for these studies was grown in the Guatemala City area (elevation 5,000 feet). It was tested (a) as a replacement for the carbohydrate base of the V M 8 mixture and (b) as a source of lysine, which is one of the limiting amino acids of all-vegetable protein mixtures for chicks (8).

Straight run 3-day old New Hampshire chicks were employed. No more than 12 chicks were housed in each all-wire cage. Heat was thermostatically controlled as required by the age of the bird. All experimental animals received water and feed *ad libitum*, and were weighed individually each week for a 35-day period. The rations fed, number, growth and the efficiencies of feed utilization of the chicks are presented in Table 1.

RESULTS

Ground buckwheat was first tested as a substitute for corn and sorghum. In experiment 1, the buckwheat was fed to replace 0.0%, 33.3%, 66.6% and 100.0% of the ground corn of an all-vegetable protein diet containing sesame, cottonseed and corozo oil meals as the principal sources of proteins. The significant linear response in the growth of the chicks and increased efficiency of feed utilization to each increased percent of buckwheat except the first indicates that buckwheat was superior to corn in these rations.

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TABLE 1
Effect of ground buckwheat as a substitute for the carbohydrates of corn and sorghum and as a supplemental source of lysine in all-vegetable protein rations for baby chicks

	Experiment 1				Experiment 2			Experiment 3		Experiment 4				
	1	2	3	4	1	2	3	1	2	1	2	3	4	5
Sesame oil meal	16.0	16.0	16.0	16.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0
Cottonseed oil meal	16.0	16.0	16.0	16.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0
Corozo oil meal	10.0	10.0	10.0	10.0	—	—	—	—	—	—	—	—	—	—
Ground corn	54.0	36.0	18.0	—	—	—	—	—	—	—	—	—	—	—
Ground sorghum	—	—	—	—	49.7	24.8	—	—	—	—	—	—	—	—
Ground whole buckwheat	—	18.0	36.0	54.0	—	24.9	49.7	49.3	49.7	49.7	49.5	49.3	47.7	45.7
Minerals	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Cod liver oil	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
APF	0.7	0.7	0.7	0.7	—	—	—	—	—	—	—	—	—	—
Lysine	—	—	—	—	—	—	—	0.4	—	—	0.2	0.4	—	—
Blood meal	—	—	—	—	—	—	—	—	—	—	—	—	2.0	4.0
Kikuyu	—	—	—	—	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Average protein	20.0	20.0	20.0	20.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0
No. of Birds, trial 1	12	12	12	12	24	24	24	24	24	24	24	24	24	24
No. of Birds, trial 2	24	24	24	24										
Av. final Wt. trial 1 g.	200	260	309	355	215	294	352	324	322	334	304	352	355	351
Av. final Wt. trial 2 g.	186	258	333	390										
Effic. Feed Util. trial 1 ¹	3.21	3.86	2.93	2.29	2.83	2.58	2.66	2.58	2.69	2.58	2.79	2.61	2.67	2.63
Effic. Feed Util. trial 2	2.98	2.98	—	—										
Significance	Linear component highly significant				LSD 0.05 = 32			not significant		LSD 0.05 = 36				

¹ Grams of feed to produce 1 g. gain in weight.

In experiment 2, buckwheat was fed to replace the ground sorghum of an all-vegetable protein mixture containing sesame and cottonseed meal as the principal sources of protein (V M 8). The diets fed, number and growth rate of the chicks and efficiencies of feed utilization are presented in Table 1. It is obvious from the data that buckwheat was also superior to sorghum in the V M 8 type formula.

Results of experiments 1 and 2 were believed to indicate that the improvement observed in the growth of chicks fed buckwheat instead of corn or sorghum was due to its higher lysine content. To determine whether adding lysine would produce a further increase in growth, 0.4% was added to the vegetable ration containing buckwheat instead of corn. No additional effect of lysine on growth was observed. As may be seen in the table, the addition of the lysine had no apparent effect on chick growth. The lack of any supplemental value of lysine in this diet was tested again in experiment 4. In this trial, the ration containing the buckwheat was supplemented with 2 levels of (a) 1-lysine and (b) a dried blood meal which was added as a natural source of lysine (8). Data in the table show that again there was no apparent benefit from the addition of 1-lysine or dried blood meal as shown by chick growth and efficiency of feed utilization.

DISCUSSION

All-vegetable protein rations for baby chicks are usually deficient in lysine (8). The data of these trials indicate that when ground buckwheat replaced corn or sorghum in a simplified all-vegetable protein formula (INCAP V M 8), the lysine requirement of the chick was apparently satisfied. This was supported by the fact that the addition of two levels of 1-lysine or of a dried blood meal, used as a natural source of lysine, did not have any further effect on chick growth or efficiency of feed utilization.

Results show that buckwheat could become an excellent substitute for the corn or sorghum in an all-vegetable protein mixture for baby chicks. From the standpoint of the ease of cultivation and yield, buckwheat should be more widely used in baby chick rations.

The sensitizing effect of raw buckwheat in several animal species is well known (4, 10, 11); it produces an occasional eruption and irritation of the skin upon exposure to light. This need not interfere with its potential use in vegetable formulas for human consumption since these are invariably cooked and since buckwheat flour has been extensively used as a staple of human diets.

SUMMARY

Ground buckwheat, *Fagopyrum esculentum*, was found to be superior to corn and sorghum in an all-vegetable protein mixture containing sesame and cottonseed oil meals as the principal protein sources in rations for baby chicks. The data suggest that the improved growth of the chicks resulted from the additional lysine supplied by buckwheat in such a mixture.

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