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UTILIZATION OF SOME ALGAE IN THE POULTRY FEED

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Mass culture of algae were prepared to feed poultry birds. Three species were selected as test algae which include one species of coccoid green algae (*Chlorella vulgaris*), one from filamentous green algae (*Spirogyra ellipsospora*) and a thalloid marine green algae (*Ulva lactuca*). Attempts were made to achieve a low cost feed with high nutritional potential. It was observed that the birds (chick broiler) feeding on coccoid and thalloid green algae showed best results in terms of yield and quality of meat.

Key words: Algae, Feed, Poultry.

Introduction

War against hunger has directed the attention of world to investigate an alternate and noble source of edible protein or as food supplement. Research revealed that algae offered an appealing solution to the food shortage because of its short growing time, ease with which they are modified genetically; and new strains can be developed which grow at faster rate, and also have the ability to grow at higher temperature such as at Karachi.

Unlike conventional crops, production of algae could be carried out continuously in the culture vessels independently of the climate changes in the outdoor culture units [1]. Waste disposal problems in algae are also minimum as compared to other processes of food production.

Experiments on algae as a source of protein, for animals and to some extent for human, have also been undertaken by Burlow [2], Bjarkman [3], Tamiya [4] and Bartos [5]. Algae give relatively high yield of biomass from the illuminated area due to utilization of solar energy during all seasons. Secondly, it has a very good composition of biomass in relation to micronutrients. Thirdly, in algal culture physical factors can be controlled more precisely than for higher plants. And unlike crop plants photosynthetic efficiency of algal culture is as high as 25% of light energy. In this regard Setlik [6] has determined that biological value of algal protein is fairly high due to the presence of almost all essential aminoacids. Cattle fed on algal protein exhibit 50% higher yield than cattle that grazed on grass [7].

In Pakistan, shortage of animal protein for food has created a wide gap between the supply and demand of meat in the rural as well as in urban areas [8]. In this regard progress can be made in poultry industry by feeding algae which can cater to the need of a well balanced diet in a shorter period of time. The purpose of this research is to evaluate the nutritive value in the selected species of algae when fed to poultry.

Materials and Methods

Collection. Water samples containing *Chlorella vulgaris* and *Spirogyra ellipsospora* were collected from lakes, rivers, ponds, and ditches from many places of Sindh region [9], while *Ulva lactuca* was collected from Karachi coast. These samples were dried and then macerated into powder. Algal material was utilized for feeding experiments in raw state.

Biochemical composition of algae utilized for feeding experiments. Chemicals used were of reagent grade quality and utilized without further purification. All solvents were anhydrous and of highest purity, and utilized as such.

Microalgae was prepared in the laboratory with the help of mass culture apparatus [1].

Before drying, all the samples were washed under running water to remove the soil and other unwanted materials, then dried in an oven at 80 - 90°, ground to obtain a homogenous powder. These samples were stored in screw capped containers at 27 - 30° and their chemical constituents were determined as follows:

Moisture was determined by the method of AOAC [10]. Ash was also determined by AOAC [11]. Total protein contents were determined by Micro - Kjeldal method [12]. Total fats were determined by soxhlete apparatus, [13]. Crude fiber was determined by the standard AOAC method [14]. Aflatoxin in feed stuff was determined by standard method of AOAC [11]. Gross energy was estimated by Bomb calorimeter (Parr adiabetic Model 1242). Heavy metals were estimated by the atomic absorption (Unicam sp. 90-A, series-2ABS). Phosphate was determined by AOAC method [10]. DNA was estimated by Schneider's method [16]. RNA, was estimated by taking the difference at total nucleic acid and DNA concentration, in the sample.

Feeding Experiments:(a) Preparation of broiler house. Healthy, uniform, high quality broiler chicks from the same parent flock (one day old, wt 60 gm each, Indian river variety, FS 99) were selected for experimental purpose.

The experimental broiler house was located in a clean, healthy surrounding at the Karachi University Campus. Temperature and humidity were controlled. Experimental birds were kept in one sq. ft. space per bird. Floor of the house was covered with new absorbent type litter and space in between the litter and feed was covered by papers so that the chicks do not pick litter. Litter was changed weekly.

Lighting of brooders was started before 24 hrs of the arrival of chicks, temperature of the house was maintained at 90 - 95°F (32 - 35°). New chicks were immediately placed under the brooder. For young chicks, small low edged plastic trays and plastic drinkers were provided in the beginning for about two weeks.

Chicks were given 24 hrs light upto two weeks. The light was reduced gradually about one hour weekly upto fourth week. Breeding temperature was maintained according to the sequence: 1st week 90-95°, 2nd week 85 - 90°, 3rd week 80-85°, 4th week 75-80° and 5th week 70-75°F.

Preparation of feed. The protein required for broiler starter is 24% and for broiler finisher is 20% (Hyline Broiler Management, 1984). The commercial feeds of broiler starter and broiler finisher were purchased from Sindh Feed and Allied Products.

Algal powder was mixed with commercial feed in the ratio of 2, 4, 6, 10 and 12% respectively. The mixing was carried out in micro mixture. Fresh, clean and sweet water was given to drink.

Vaccination. Broiler were vaccinated against Newcastle disease, vitamin mixture was provided in drinking water after each vaccination.

Organoleptic analysis. The method used was based on scoring different tests described by Larmond [15]. In this regard a scale was worked out which extended between eleven (excellent) and one (very poor) for each of the following parameters. Raw odour, texture, colour and cooked flavour. The scores were given as (Fig. 7) average score points awarded by a panel of ten trained staff members of Poultry Research Institute and members of staff and postgraduate students of Department of Botany, University of Karachi (Table-2).

Results and Discussion

Biochemical composition of *Chlorella vulgaris, Spirogyra ellipsospora* and *Ulva lactuca* (Table 1) showed that moisture contents in all the three species were very uniform and ranged between 8 - 11%.

The ash content in *Ulva lactuca* was higher as compared to freshwater algae, ranging from 10 - 26% of dry weight.

Crude fat content of *Chlorella vulgaris* was very high as compared to other algae. This species appears to have a high content of protein, ranged between 44 - 50% as compared to the species of *Spirogyra* and *Ulva* (Table 1).

Crude fiber is also higher in *Chlorella vulgaris* as compared to other algae, ranged between 1 - 6% dry wt. However, a high quantity of nitrogen free extract was obtained from species of *Ulva* and *Spirogyra* as compared to *Chlorella vulgaris* (Table 1).

Total nucleic acid which was measured in micro grams/100 g, was more in *Ulva* and *Chlorella* than in *Spirogyra.* The quantity of DNA and RNA measured in micro grams/100 g shows greater value in *Ulva* and lesser in *Spirogyra* and nil in the broiler starter and broiler finisher feeds (Table 1).

Calorimetric test (Table 1) revealed that *Chlorella vulgaris* had highest gross energy as compared to *Ulva lactuca, Spirogyra ellipsospora*, broiler starter and broiler finisher.

Considerable variation occurs in the percentage composition of algae and commercial feed. Biochemical analysis of all ingredients used is described below separately.

In *Ulva lactuca*, due to high ash contents, gross energy is lowest i.e. 2920 K.cal/kg; in *Spirogyra ellipsospora* it is 3144

TABLE 1. BIOCHEMICAL COMPOSITION OF ALGAE UTILIZED IN POULTRY FEED.

Sample	Moisture gm%	Ash gm %	Crude fat gm%	Crude protein gm%	Crude fiber gm%	Nitrogen free extract	Total nucleic acid gm	DNA µg/ 100mg	RNA µg/ 100mg	Gross energy K.cal/ kg	Afla-toxin
U. lactuca	10.78	26.32	5.61	14.95	5.084	37.25	241	144	97	2920	-ve
	+0.012	+.014	+.009	+.004	+.000	+.0009	+.0091	+.009	+.110	+.000	
S. ellipsospora	9.62	24.39	5.6	21.09	1.959	37.33	98	73	23	3144	-ve
	+0.009	+.005	+0.08	+0.004	+0.000	+0.000	+0.036	+0.016	0.009	+0.091	
C. vulgaris	8.50	10.00	15.11	44.30	6.02	16.05	229	–	–	4403	-ve
	+0.005	+.08	+0.004	+0.009	+0.000	+0.0135	+0.004			+0.040	
Broiler	9.5	8.9	5.21	24.71	2.8	48.87	–	–	–	3924	-ve
starter (feed)	+0.070	+.04	+0.009	+0.000	+0.004	+0.004				+0.091	
Broiler	11.0	10.2	4.8	20.25	2.98	50.77	–	–	–		-ve
finishner (feed)	+0.04	+.04	+0.004	+0.0026	+0.004	+0.009					

K.cal/kg, it is also ranked higher as regard to nitrogen free extract (Table 1) whereas in commercial feed, gross energy was from 3924 - 4142 K.cal/kg.

Conclusion

Hence it is apparent from the data that planktonic algae like *Chlorella* could be utilized as a cheap source of protein or as supplement to the staple food in those areas where daily intake of calorie is met by the consumption of food of high carbohydrate content.

The day old chicks were fed on broiler starter, containing algae in the ratio of 2,4,6,8,10 and 12% of *Chlorella vulgaris*, *Spirogyra ellipsospora* and *Ulva lactuca*. Figures 1-6 show that feeds with *Chlorella vulgaris* showed best results as compared to other algae. Second comes *Ulva lactuca* which also showed better results than *Spirogyra ellipsospora*. Besides this, Table 2 shows the effect of algae on the health of birds. A high rate of mortality i.e. 3% was observed in the controlled diet whereas the birds which were fed with the

TABLE 2. MORTALITY RATE OF EXPERIMENTAL BIRDS DURING 1-8 WEEKS PERIOD.

Groups (% sample)	Total no.of birds	Mortality observed			
		Spirogyra ellipsospora	*Ulva lactuca*	*Chlorella vulgaris*	Control
0 (control)	10	–	–	–	3
2	Nil	Nil	Nil	Nil	
4	Nil	Nil	Nil	Nil	
6	Nil	Nil	Nil	Nil	
8	Nil	Nil	Nil	Nil	
10	Nil	Nil	Nil	Nil	
12	Nil	Nil	Nil	Nil	
Total	190	Nil	One	One	Three

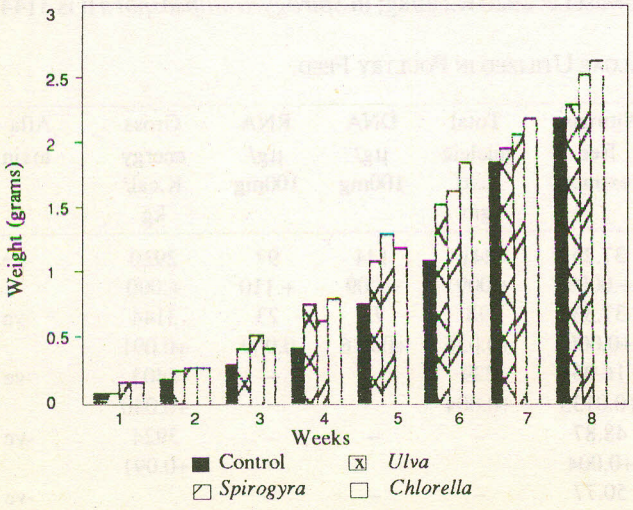

Fig. 1. Effect of 2% algal feed on body weight of chicken bird. Indian river broiler, variety FS 99. (For 1-8 weeks period).

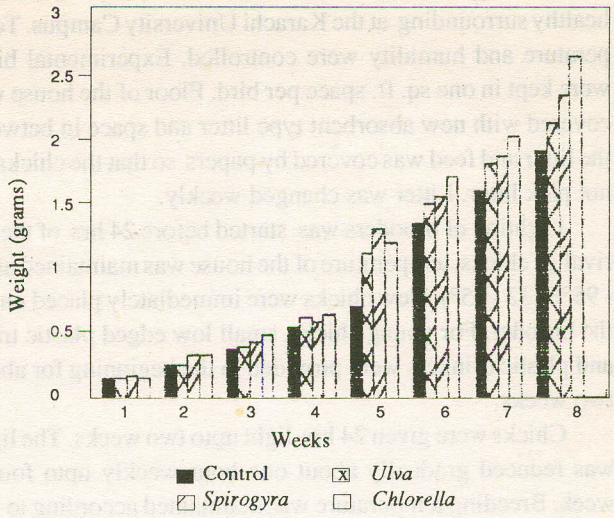

Fig. 2. Effect of 4% algal feed on birds.

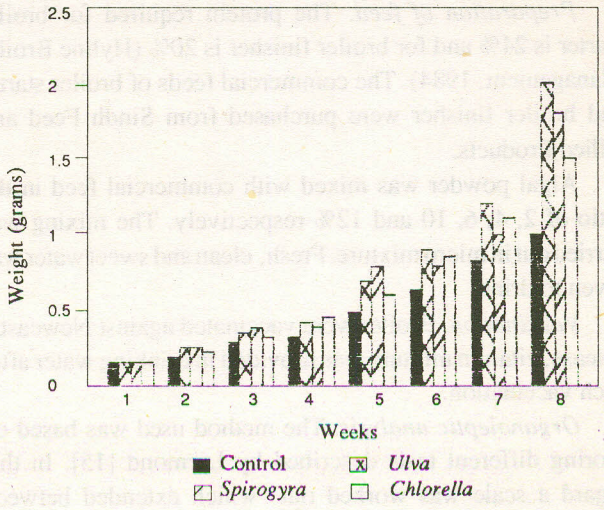

Fig. 3. Effect of 6% algal feed on birds.

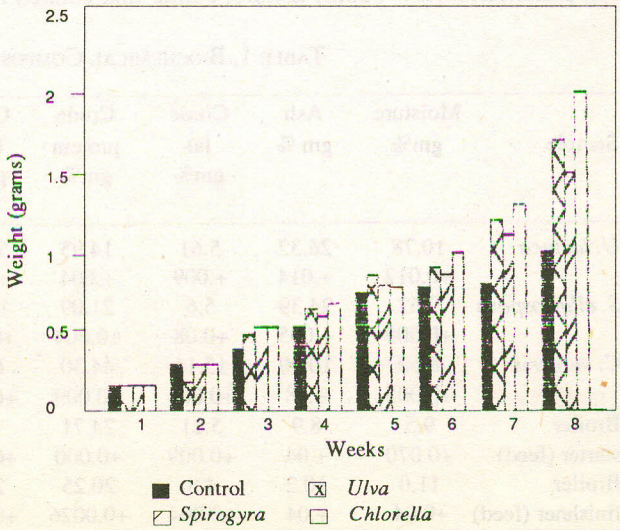

Fig. 4. Effect of 8% algal feed on birds.

supplements of *Ulva lactuca* and *Chlorella vulgaris* showed lower rate of mortality (i.e. 1%). Not a single death was observed in feeding with the supplement of *Spirogyra ellipsospora*. Therefore it is concluded that diet containing spirogyra proved resistant against seasonal diseases during the course of experiments.

Results of organoleptic analysis or mean sensory responses (MSR) of individual samples are shown in Figs 7,8. Each point represents an average score for flavour, texture and appearance (FTA), raw chicken meat (olfactory) and cooked chicken meat (gustatory). The mean average score ranged between 9.0 - 9.6, increase of "olfactory" response and between 7.1 - 7.8 in "gustatory" response.

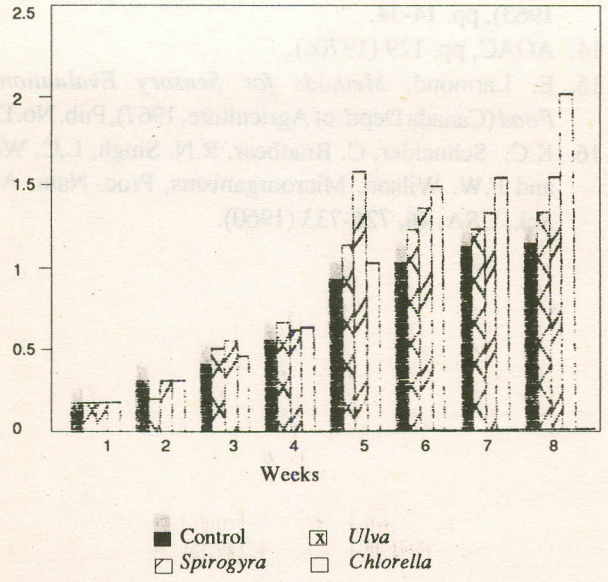

Fig. 5. Effect of 10% algal feed on birds.

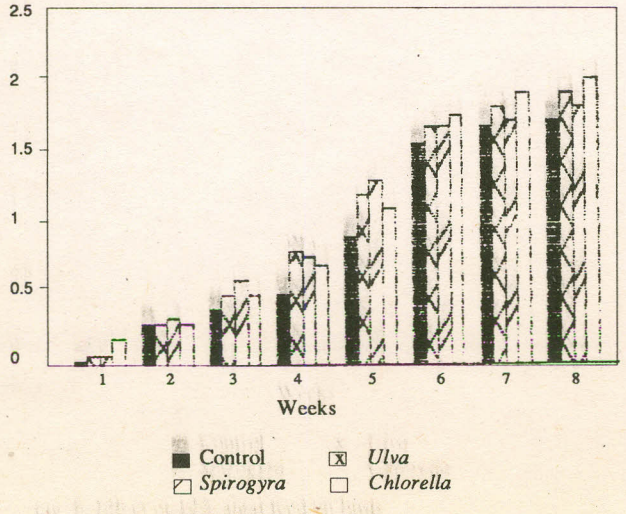

Fig. 6. Effect of 12% algal feed on birds.

It is further shown that favourable remarks of the panel of judges for the flavour, texture and appearance were as good as those for chickens which were fed on control feed. Being an eight weeks old chicken its meat was soft and tasty and therefore, it was relished.

Reasons for selection of broiler chicks as test animals. Broiler production is a mean of generating quick return from poultry over shorter period of time, being a quick means of converting feed into meat. Therefore, the capital pay back in broiler production is faster than for layer hens.

Considering the fact that cost of feed depends on the level of protein, so it is seen that a better meat quality and production was achieved by using algal feed. There is, however, no doubt that results may be implemented in present state and steps should be taken by the Government and private sector in this regard.

Determination of chemical constituents and nutritional studies show that a number of selected strains of algae could commercially be utilized as a cheap and valuable source of protein which could further be utilized in feed as food supplement to poultry and indirectly to man.

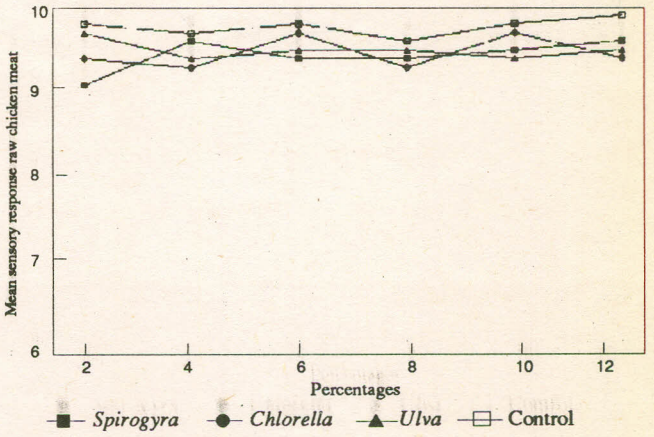

Fig. 7. Effect of % of different algal strains on the quality of chicken meat.

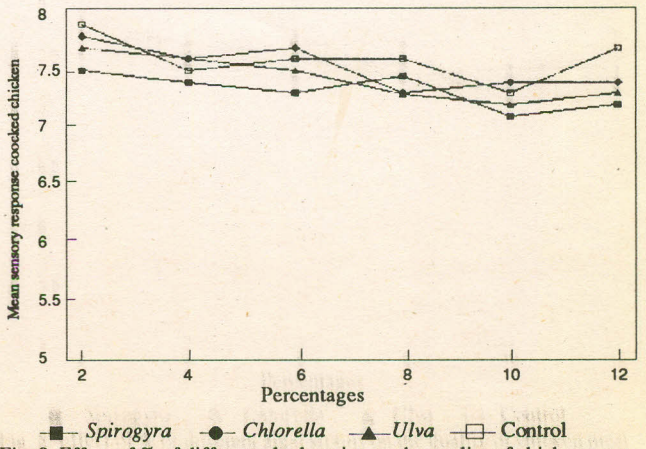

Fig. 8. Effect of % of different algal strains on the quality of chicken meat.

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