TAPIOCA SPENT PULP AS AN INGREDIENT IN POULTRY FEED

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INTRODUCTION

IN view of the growing shortage of food for man and animals, particularly in countries like India, many attempts are being made to augment its production by better utilization of the available resources. One of the ways of increasing the food for human consumption is through livestock, for which new sources of feed supplements such as treated organic wastes of suitable nature may be found. One such material, activated sludge containing proteins and other substances especially vitamin B_{12}, as a feed supplement for poultry was recently examined by us.[1] More recently we have collected evidence on the possible use of tapioca spent pulp as an energy-providing ingredient in the poultry feed, and the present communication deals with this evidence.

SOME ASPECTS OF TAPIOCA

The tapioca plant.—Tapioca (Cassava, a tuber plant) is one of the miscellaneous food crops of South India.[2] This is a predominantly tropical plant, reported to be a native of Brazil (South America) where it has been grown from ancient times.[2] In India, for over a century this plant has been grown as a subsidiary food crop, particularly in Kerala and Madras States.[3,4] During the Second World War, due to short supplies of starch and rice, the cultivation of tapioca received an impetus, and in 1958 the area under this crop in this country was about 614 thousand acres yielding about 1,768 thousand tons of the crop.[3] Information on production and consumption of tapioca starch in textile industry is also available.[3]

The toxic substance in tapioca and its elimination.—There are two varieties of cassava: the sweet variety and the bitter variety. Of these, the bitter variety (*Manihot utilissima* Pohl.) is preferred for the production of starch from its tuberous roots.[3] This variety contains more prussic acid or hydrocyanic acid,[3,5] a toxic substance "first recorded by Boutron-Charlard in 1836, though the fact that the toxicity of this material was due to a volatile constituent was first established by Henry and Boutron-Charlard in 1833".[6] A cyanogenetic glucoside, linamarin, and an enzyme linase which hydrolyses it are also present in the tuber.[3] The toxic substance is present more near the cortical layers than in the interior of the roots.[2] The pulp from six varieties of cassava grown in Nigeria contained from 29 to 213 mg HCN per kg. fresh matter. In general, there was more HCN when there was no rainfall. Values for peel, which constituted 18% of the whole root, were from 5 to 10 times greater than those for pulp.[7]

The major part of the toxic substance in the tapioca tuber can be eliminated by peeling the tuber and washing, sun-drying after slicing or cooking with water for 5 minutes.[3] Nutritional experiments with tapioca have been carried out.[8–13]

Tapioca spent pulp.—In the extraction of starch and sago from tapioca a fibrous waste is obtained as a by-product (yield 10 to 20%),[14] which is free from the toxic substance and contains a considerable amount (56·2%)[14] of starch. This waste, if it is not properly disposed of, undergoes putrefactive changes and causes atmospheric pollution. Such a problem in environmental hygiene and sanitation arose at one of the industrial establishments.[15] Attempts have been made to extract a part of the starch or to use the whole material as a cattle feed or as fuel.[14]

The studies on the nutritive value of tapioca spent pulp as a cattle feed indicated (*a*) that the total digestible nutrient value and starch equivalent worked out to be 71·12 and 68·09 kg. per 100 kg. tapioca spent pulp, and (*b*) that inclusion of the spent pulp in the

* Deceased.

TABLE I
Chemical composition of the ingredients of the poultry mash
(Per cent on oven-dry basis)

Ingredient	Organic matter	Crude protein	Ether extract or crude fat	Crude fibre	Nitrogen-free extract	Total carbo-hydrates	Ash or mineral matter	Calcium (Ca)	Phosphorus (P)
Tapioca spent pulp	95·87	2·25	0·28	14·39	78·95	93·34	4·13	0·29	0·05
Ragi flour ..	91·77	7·95	1·05	5·14	77·63	82·77	8·23	0·33	1·57
Wheat bran ..	94·53	16·15	3·48	12·12	62·78	74·90	5·47	0·08	1·06
Yellow maize ..	98·11	10·53	3·85	2·25	81·48	83·73	1·89	0·03	0·38
Rice polish ..	83·55	15·67	14·85	10·37	42·66	53·03	16·45	0·16	1·81
Groundnut cake ..	94·23	50·25	5·82	4·95	33·21	38·16	5·77	0·10	0·56
Fish meal ..	73·67	55·67	8·55	1·15	8·26	9·41	26·33	8·15	7·24
Mineral mixture ..	..	..	..	..	..	..	80·53	24·23	9·35
Shell grit ..	..	..	..	..	..	..	..	38·35	..

rations of Thari cows resulted in a positive balance of nitrogen and calcium and a slight negative balance of phosphorus in the animals.[16]

The use of tapioca spent pulp as a feed ingredient to replace the costlier sources of energy-providing millets or cereals in the diet of laying birds has not been examined. We have carried out experiments to study the effects of partial replacement of flour of ragi (*Eleusine coracana*) by tapioca spent pulp in the diet of hens on egg-laying. These experiments and the results are briefly described here.

EXPERIMENTS WITH TAPIOCA SPENT PULP

Materials and methods.—The tapioca spent pulp used in the experiments was obtained from Messrs. Laxmi Starch Factory, Ltd., Kundara, Kerala State, to whom the authors' thanks are due. Feeding experiments were carried out at the Central Poultry Farm, Hessaraghatta, of the Department of Animal Husbandry and Veterinary Services, Government of Mysore.

The ingredients of the poultry mash were analysed for their nitrogen, crude fat, fibre, calcium and phosphorus contents by the methods recommended by the A.O.A.C.,[17] and the results are given in Table I. For feeding the birds the following two mashes were prepared (Table II): (*i*) the control mash, generally used in the farm, and (*ii*) the mash in which 50% of the ragi flour was replaced by tapioca spent pulp. By this substitution, the experimental mash contained 10% of the pulp and the two mashes were nearly isoproteinous and isocaloric.[18] The amino acid composition of the control mash and experimental mash has been worked out[19] in Table III on the basis of the crude protein contents given in Table II.

TABLE II
Composition of layer mash

Ingredient	Control mash	Experimental mash
Ragi flour ..	20	10
Tapioca spent pulp ..	..	10
Wheat bran ..	10	10
Yellow maize ..	10	10
Rice polish ..	30	30
Groundnut cake ..	20	20
Fish meal ..	5	5
Shell grit ..	2	2
Mineral mixture ..	1	1
Others (proprietary antibiotic mixtures, etc.)	2	2
Total ..	100	100
Crude protein % ..	19·6	19·1
Digestible crude protein %	15·7	15·3
Total digestible nutrients %	65·5	65·6

TABLE III
Amino acid composition of the mashes

Amino acid	Control mash g./kg.	Experimental mash g./kg.
Arginine ..	19·99	19·75
Histidine ..	8·73	8·60
Lysine ..	8·73	8·60
Tyrosine ..	7·92	7·86
Tryptophane ..	2·27	2·18
Phenylalanine ..	10·55	10·23
Cystine ..	3·34	3·13
Methionine ..	3·84	3·54
Threonine ..	5·68	5·47
Leucine ..	17·98	17·36
Iso-leucine ..	8·25	7·86
Valine ..	12·00	11·57

60 six-months-old White Leghorn hens were divided into two groups of 30 each. One of these groups of birds were fed on the control mash and the other group were fed on the

TABLE IV

Egg-laying record of the birds fed on the control and experimental mashes

(Number of eggs laid by a group of 30 birds on each mash is given. The average yield per day is given within brackets.)

Mash	February	March	April	May	June	July	August
Control ..	558 (19·2)	680 (21·9)	667 (22·2)	670 (21·)	646 (21·5)	600 (19·4)	660 (21·3)
Experimental ..	668 (23·0)	717 (23·1)	745 (24·8)	749 (24·2)	694 (23·1)	685 (22·1)	755 (24·4)

$F_{1,6} = 61·98$; significant at 1% level.

experimental mash. Observations on the egg-laying and on the health of the birds were carried out over a period of seven months.

Results.—The egg-laying record of the birds on the two mashes is given in Table IV. These results indicate that there was an increase in the number of eggs laid by the birds when they were fed on the mash containing tapioca spent pulp.

The increases in the numbers of eggs laid during the seven months ranged from 5·4 to 19·7%; the average increase in egg-laying due to the inclusion of tapioca spent pulp was 11·9%. Also, during this period of observation, the birds did not show any untoward symptoms. They were healthy.

The manner in which the tapioca spent pulp exerted its beneficial effect on the hens in the increased production of eggs is not clear. The diets for the control and experimental hens were not only isoproteinous and isocaloric but also contained nearly the same amounts of calcium and other minerals (Tables I and II).

Whether the tapioca spent pulp at the dosage at which it was used contains something (unlike ragi) that is conducive to hens for egg-laying remains to be investigated.

SUMMARY

Some aspects of tapioca have been considered, with special reference to the possible utilization of the spent pulp which is a waste material in the production of starch from tapioca. This starch waste or spent pulp may be utilized as an ingredient in poultry feed.

Experiments were carried out with White Leghorn hens over a period of seven months in order to study the effect of replacing 50% of ragi flour by tapioca spent pulp in the feed of the birds, particularly on their health and egg-laying. The birds were healthy and laid more eggs. There was, on the average, about 12% increase in the number of eggs laid as a result of inclusion of tapioca spent pulp in the feed.

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