RESULTS & DISCUSSION

1. Percentage of edible portion of "Hindi" banana fruit "Musa cavendishii"

Results present in Table (3) shows calculated number of fingers, average finger weight (in gm.) and percentage of edible portion wt.

Table 3 - Total wt, fingers number, average finger wt. edible portion wt. and edible portion percent of banana.

Total fruit wt. in gm.	Finger number	Average finger wt. in gm.	Edible wt. gm.	Edible portion %
395	7	56.4	247	62.53
500	8	55.5	317	63.40
780	14	55.7	484	62.05
988	17	58.1	682	69.02
1000	18	55.5	650	65.00
1500	26	58.7	1020	68.00
1910	34	56.1	1197	62.67
1940	30	64.6	1070	55.15
Average of 1000 gm.	17	58.8	628.7	62.87

The data obtained in Table (3) shows that one kg.

Table 4 - Chemical composition of both banana pulp and peel calculated on dry basis

	Pulp	Peel	Remarks
Moisture content	75.7	88.0	%
Ash content	3.6	16.9	%
Phosphorus	88.38	76.9	mg/100 gm.
Calcium	70.19	442.0	%
Iron	00.47	1.65	%
Crude fibers	1.55	12.80	%
Total nitrogen	00.82	1.74	%
Non-protein N	00.26	0.34	%
Protein N	00.55	1.38	%
* Crude protein	3.44	8.61	%
Ether extract	2.29	7.21	%
Vitamin C (ascobric)	40.00	23.50	mg/100 gm.
Vitamin B_1 (Thiamin)	00.08	00.08	"
Vitamin B_2 (Riboflavin)	00.95	1.08	"
Starch	14.60	7.99	%
Total sugars	76.12	27.49	%
Pectin	2.3	3.40	%
** Other substances	0.25	35.22	%

* Crude protein = N x 6.25

** Calculated by difference

It will be observed that there is a remarkable differences in the ash content of the peel (16.9%) which is as about five times higher as that of the pulp (3.6%).

It will be also noticed that both calcium and iron contents are higher in peel (442 and 1.165 mg/100 gm. respectively) rather than in pulp (70.19 and 0.47 mg/100 gm. respectively). On the other hand, phosphorus content was slightly higher in pulp (88.38 mg/100 gm when compared with that of the peel (76.9 mg/100 gm). The obtained high ash value of the peel seems reasonable. A probable explanation for this high value could be attributed to the high mineral and fiber contents which was approximately 12.8% for the peel and 1.55% for the pulp.

As regard to the nitrogen containing substances in banana, it was also higher in the peel (1.74%) rather than in the pulp (0.82%). These obtained values are in agreement with that obtained by Menessy and Nassar (1965), who reported that the nitrogen containing substances of the peel and pulp of Musa cavendishii were 1.64 and 1.19% respectively. The figures mentioned for crude protein were obtained by using the factor (protein nitrogen x 6.25).

The acquired high ethyl ether extractive matters in the peel (7.21%) and the pulp (2.29%) does not agree with the reported values of Adriaens (1953) as he mentioned that fat contents of banana fruit was 0.05 - 0.12%. The high ethyl ether extract content obtained may be attributed to the presence of some other pigments which might be extracted by ethyl ether together with the lipids.

The same Table (4) shows also quite interresting data concerning vitamin contents of banana fruit. Vitamins C, B_1 and B_2 were identified and proved to be present in both pulp and peel in fairly reasonable amounts when compared with the daily requirement of each vitamin (The daily requirements of vitamins C, B_1 and B_2 are 30, 1, 1.7 mg. respectively).

In this respect, vitamin C content in pulp is twice that of the peel (40 and 23.5 mg/100 gm respectively). However, Thronton (1943) reported a higher amount of ascorbic acid in banana pulp (Musa sapientum) at the yellow stage. The decreased values for acrobic acid in this study could be due to either the used sp. (Musa cavendishii) or to the hpmogenization process which preceded the chemical analysis and might facilitate the enzymatic oxidation of

ascorbic acid in the presence of air, which goes almost with the same finding of Mullor et al. (1968).

The other two identified vitamins were B_1 (thianin) and B_2 (riboflavin). These exist in nearly similar amounts in both banana pulp and peel, B_1 is 0.08 mg/100 gm. whereas, B_2 amounted to 0.95 and 1.08 mg/100 gm in the pulp and peel respectively.

Carbohydrate in bananas requires special mention. They contain much larger amounts of it than most fruits and so can act as a useful source of energy. Carbohydrate varies with the different parts of the fruit, i.e., the pulp and peel. The obtained data also indicated that, the total sugar contents were much higher in pulp (76.13%) than in the peel (27.54). The determined starch in the pulp was about twice (14.6%) as much as that of the peel (7.99%). On the other hand, pectin substances were slightly higher in the peel (3.4%) than in the pulp (2.3%).

The presence of sugar in banana lead to further investigators to identify and estimate the individual sugars in both pulp and peel. Table (5) list up the results.

Qualitative and quantitative analysis of sugar contents of banana pulp and peel :

Banana pulp and peel were chromatographically analysed to identify and determine the sugar contents. They were examined for Arabinose, fructose, galactose, glucose, maltose, mannose, mellobios, refinos, sucrose and xylose. The results (calculated on dry matter basis) are given in Table (5), and shown in Fig. (1).

Table 5 - Sugars contents of banana pulp and peel calculated as (gm/100 gm dry basis).

Sugars	Pulp %	Peel %
Arabinose	0.00	0.00
Fructose	12.34	23.33
Galactose	0.0	0.0
Glucose	6.17	Trace
Maltose	0.0	0.0
Mannose	0.0	0.0
Mellobiose	0.0	0.0
Rafinose	0.0	0.0
Sucrose	57.61	4.16
Xylose	0.0	0.0
Total	76.12	27.49

Fig. 1 - Sugars contents of banana pulp and peel.

It will be seen that the pulp is more rich in sugar contents than the peel. Sucrose and glucose are present in the pulp in a higher level than those of peel. Glucose is present in peel in trace amount, but fructose was found to be about as twice (23.33) as that of pulp (12.3%) in the ripe stage of banana. The presence of 27.49% of sugars in peel might give the peel its possible nutritive value especially as animal fodder.

Sucrose represents the major component of pulp (57.61%) which reflects the sweet taste of banana flesh. The peel contains about only 4% of sucrose. Arabinose, galactose, mannose, mellobiose, maltose, rafinose, and xylose were absent in both pulp and peel. The data presented in this work (Table 5) demonstrate that sugars present in banana are chiefly sucrose, fructose and glucose; this goes in line with Wali and Hassan (1965) in their ihvestigations on the same species.

Amino acid contents of banana :

Table (6) and Fig. (2) shows the amino acid contents and essential amino acids as mg/100 gm of dry matter basis of both banana pulp and peel. The same table also, presents calculated data as per 16 gm of nitrogen in comparison with

Table 6 - Amino acids content of banana pulp and peel as comparing with FAO reference protein.

Amino acids	Dry wt. mg/100 gm.	gm/ 16 gm. N. !	T.d.A.A. % +	Dry wt. mg/ 100 gm.	gm/ 16 gm. N.!! ..	T.d. A.A. %	FAO ref. protein 16 gm. N
⁎ Leucin + isoleucine	80	2.32	5.63	104	1.20	4.46	9.0
⁎ Phenyl alanine	106	3.08	7.46	106	1.23	4.55	2.8
⁎ Methionine	00.0	0.00	0.00	64	0.74	2.74	2.2
⁎ Valine	80	2.32	5.63	74	0.88	3.17	4.2
⁎ Threonine	38	1.10	2.67	84	0.97	3.60	2.8
⁎ Lysine	52	1.51	3.66	42	0.48	1.80	4.2
Cystine + cystiene	172	5.00	12.11	344	3.99	14.77	
Thyrosine	100	2.90	7.04	340	3.44	14.60	
Alenine	72	2.09	5.07	56	0.65	2.40	
Glutamic acid	182	5.29	12.81	180	2.09	7.73	
Aspartic acid	260	7.55	18.30	432	5.01	18.55	
Serine	100	2.90	7.04	126	1.46	5.41	
Glycine	98	2.84	6.90	126	1.46	5.41	
Histidine	80	2.32	5.63	240	2.78	10.31	
Isobuteric acid	0.00	0.00	0.00	10	0.11	0.43	
TOTAL	1420	41.22	99.95	2328	26.97	99.93%	

⁎ Essential amino acids.

\+ T.d.A.A. = Total determined amino acid.

! Total protein 3.44%

!! Total protein 8.61%

Fig. 2 - Amino acids contents of banana pulp and peel.

the FAO provisional pattern of protein (1957).

The obtained data for total determined amino acid (Table 6) shows that pulp aquire higher values for the following amino acids : leucine and isoleucine, phenylalanine valine, lysine, alanine, glutamic acid, serien and glycine. While peel shoots in methionine, threonine, cystine and cystien, tyrosin, histidine and isobuteric acid. Aspartic acid (18%) seems to be equal in both pulp and peel and contribute the major fraction of amino acid present in banana fruit, likewise other plant protein.

It will be noticed that both methionine and isobuteric acid were absent in banana pulp, a result which goes in agreement with that of Asker (1972, 1973) findings.

The amino acid contents calculated per 16 gm nitrogen are higher in pulp (41.2%) than that of peel (26.9%).

Although phenyl alanine seems to be the only essential amino acid of higher value, in the banana pulp studied than that of the FAO provisional pattern protein (1957), and in spite of Relvas (1959) statement that banana is considered to be one of the richest fruits in its amino

acid contents, it still remains, from the obtained data considering the essential amino acids, that both banana pulp and peel are at very low quantity and quality than the above mentioned pattern. Therefore,it is evident that neither total amino acids nor essential amino acid contents of banana fruit would place banana into consideration as a good source of protein in the diet.

PART (II)

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SOME ASPECTS ON THE THERAPEUTIC PROPERTIES and BIOLOGICAL EVALUATION of BANANA FRUIT

BIOLOGICAL REVIEW

1. Pharmacology

The available literature concerning the pharmacological activity and possible therapeutic value of banana fruit is scanty.

Pereira *et al.* (1963) reported that the banana plant contains nor-adrenaline, serotonin and 3-(3,4-dihydroxyphenyl) alanine. The stalk juice of banana produced contractions of isolated guinea pig ileum and rat duodenum and increased the blood pressure of cats and dogs. They found also, that aspasmogenic effect of banana stalk juice on guinea pig ileum were antagonized by atropine but not by nicotine or hexamethionium. The banana juice promptly increased the amplitude of beat in the isolated-guinea pig heart. The inotropic action was not antagonized by phentol amine. The hypertensive action of the stalk juice was attributed to the sympathomemetic activity.

Knapp and Nicholas, (1969) identified B-sitosterol, stigmasterol, campesterol, cyclo eucalenol, cydoartenol, and other triterpenes in banana peel.

Bueno et al. (1970) mentioned that butanol extract of banana pulp and peel contains serotonin which was present in

a high concentration in the pulp than in the peel. The amount present varied from one growing area to another.

Mahey et al. (1971) reported that fresh and dried wild banana seeds yield a mixture of proanthocyanidin glucosides.

Tranchet, (1971) found that the alcoholic extracts of the outer most layers of banana peel contain flavonal rutin and di-or tri-glucoside quercetin derivatives.

Deacon and Marsh, (1971) isolated an enzyme system from the pulp of banana fruit. The enzyme was capable of catalyzing the hydroxylation of tyramine to dopamine.

2. Protein efficiency ratio and growth rate

Chemical analysis of food items is considered as a promenent guide for the prediction of its nutritive values. Basis of more inductions can be further widened by bioassay since chemical composition alone does not show the reaction of the biological processes of the body of each constituent.

For the biological evaluation of the nutritive value of proteins, the criterion of growth in young rats has been widely used.

As early as (1919) Osborn, introduced the concept of protein efficiency ratio as a refinement of the simple growth method. Grams weight gain, versous grams protein intake, were determined for several proteins and it was found that the varying levels of proteins in the diet gave different protein efficiency ratios (P.E.R.). A rather definite level was found for each individual protein which produced the greatest gain per gram protein ingested. In general, it has been found that the better the protein quality, the lower, to a certain extent, the level in the diet required to produce the highest (P.E.R.). This implies that the biological value (B.V.) of a protein will depend on, how well balanced its amino acids contents is, with respect to the amino acid requirements of the body, to produce optimum metabolic efficiency.

Bender and Doell, (1957) reported that body weight was a reasonably accurate index of body protein in young growing rats.

The importance of protein quality rather than quantity was shown by Waggle, et al. (1966) who found that a certain sorghum variety with a low protein content was superior to another variety with higher protein content, in terms of rat

growth ratio and amino acid contents.

Nitrogen balance and growth of the rat as affected by banana fruit in the diet was studied by Siliciano and Nasset, (1953). They found that the N-balance index of absorbed-N was increased as the result of supplementing casein with banana protein. They also reported that addition of 9% fresh banana pulp as a supplement to a diet containing 10% casein's protein, failed to affect significantly the growth of weanling rats fed ad-libitum.

The possible uses of banana in animal feeding were also studied by some investigators. Agot (1968) study the nutritive value of banana and found that proteins and fats were present in nutritionally insignificant amounts. Meanwhile vitamins, except for B_{12}, were present in appreciable amounts and the starch content was as high as 20-32%.

Bressani et al. (1971) they reported that in chicken feed banana flour may replace up to 10% of the corn flour. Higher percentage gave rise to growth depression.