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Effect of Fungal Infections on Nutritional Value of Apple, Banana and Mango Fruits

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ABSTRACT
The nutritional value of fruits is mostly determined by the amount and quality of nutritious elements present. Apple, banana, and mango fruits are all susceptible to rot caused by a variety of fungi. It is highly important for the fungi to be selective in their nutritional requirements. Their observations of the stored compounds, as well as the conversion of some of the complicated forms into simpler ones, have an impact on them. Fungi were recovered from apple, banana, and mango fruits in the current experiment. On the fruit of the apple, banana, and mango, significant losses in protein, ash, and nitrogen content were detected as a result of the presence of these fungi. Amounts of amino acids in both free and bound forms increased in infected fruits, which was consistent across the board. In the majority of the fungus, a significant drop in total sugar and an increase in reducing sugar were found to exist. The purpose of this study is to evaluate the post-purchase shelf-life of three commonly consumed fruits and to determine the fungal strains that are responsible for their deterioration.
Keywords: Nutritional, quality, fungal, elements, stored, amino acids.

INTRODUCTION:

Fruits are essential for ensuring food and nutritional security, as well as providing farmers with a consistent source of income. Apple trees are the most extensively grown species in the Malus genus and are grown all over the world. The fruit's particular flavour and aroma qualities are due to the presence of esters and essential oils. Nearly one-half of the world's apple harvest is consumed as fresh fruit. It also has pectin, which is good for health. Apple juice, apple syrup, and apple cider all use a large amount of the crop. Pectin, Vitamin C, and fibre are just a few of the nutrients contained in apples. Potassium is also abundant in them. The skin of the apple contains the majority of the nutrients. Apples are high in pectin, which can help lower cholesterol levels while also boosting the gut muscle's function. It can also be used to relieve the symptoms of constipation and diarrhoea. In apple fruits infected with Rhizopus stolonifer, Singh and Prashar (1981) discovered that the decrease in non-reducing sugar was greater than the fall in reducing sugar.In India, bananas are a popular fruit crop. Bananas that have fully ripened are quite easy to digest. Banana fruit is a good source of vitamin A and vitamin C in terms of nutrition. The starch content of the fruit is gradually converted to sucrose, glucose, and fructose as it ripens, and the amount of water in the pulp increases. Because of their high moisture content and high nutrient content, matured fruits and vegetables are sensitive to microbial attack (Mehrotra, 1980). Bananas are susceptible to a variety of fungal rots when in storage and transit. As a result of such infectious rots, the fruit's market and nutritional worth are reduced, either due to its unsightly appearance or changes in the fruits' stored components. The mango is one of India's oldest and most significant tropical fruits. They come in a range of forms and sizes. Often fibrous and acidic, young and inferior fruits are unappealing. Its unique flavour, fragrance, taste, and health-promoting characteristics make it a "superfruit." It is high in prebiotic

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fibre, vitamins, minerals, and polyphenolic flavonoid antioxidants. Beta carotene, alpha carotene, and beta-cryptoxanthin are all found in mangoes. Raising the temperature during the fruit's development and maturity produces superior quality fruits. Pathak has studied many fungi that harm mangoes (1980).

MATERIALS AND METHODS

Collection of Samples: Apple, banana, and mango fruits from the local fruit market were checked for infection. They were separated in clean polythene bags and brought into the lab.

Method of Isolation and Identification of pathogens: The rotten edge were sliced into 2-5 mm pieces using a sterilized cutter. The components were washed in running water before being surface sterilized in 70% ethanol for one minute. It was then dropped on sterile soft paper. The surface-sterilized components were grown in PDA medium with streptomycin. The organism was incubated at 28°C for five days, with regular growth monitoring. The operation was repeated three times. Pure cultures of fungi linked with the strain were obtained and stored in slants for future use. Each pathogen was identified using Gilman (1971), Smith (1960), Tilak (1998) and other standard literature. The pathogenicity of different fungus isolated from diseased fruits was studied in the laboratory by following Koch's postulates.

Biochemical changes in infected fruits

Large apple, banana, and mango fruits were chosen and cleaned with distilled water to assure their health and appearance. Surface sterilization was done by soaking it in 95% alcohol and letting it dry. The fruits were infected at the stylar end with a mycelial disc cut from a pure culture of the virus cultivated on PDA. Inoculated fruits were incubated for 7 days at 90% relative humidity and 25°C. The healthy fruits were the control. Nutritional values of the healthy and infected fruits were determined.

Estimation of Nitrogen: The total nitrogen content of the sample was determined using the usual Microkjedahls method and multiplied by 6.25 to obtain the protein percent in g/l00g of the sample.

Estimation of free amino acids: Free amino acids were estimated by the method of Jayaraman (1984).

Estimation of phenol: The method is given by Sadashivam, and Manikkam (1992) for the quantitative determination of total phenol was used to conduct the experiments.

Estimation of Ascorbic acid: The estimation of ascorbic acid has done by following the method described by Sadasivam and Manickam (1992).

Estimation of total sugar: Using the methods described by Sadashivam and Manikkam (1992), we evaluated changes in total sugars and reducing sugars.

Estimation of Non reducing sugar: In order to calculate the amount of nonreducing sugar, we subtracted the value of reducing sugar from the total sugar and multiplied the result by the factor 0.95.

Estimation of total ash content: The ash content was estimated by following the method of Hart and Fisher (1971).

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RESULTS

The results are represented in tabular format

Table-1: Biochemical changes in infected apple fruits.

Fungal Pathogens	Nitrogen(%)		Protein (%)		Total sugar(%)		Ascorbic acid(%)		Total phenol(%)		Reducing sugars(%)		Non reducing sugars(%)		Total free aminoacid(%)		Total ash(%)	
	I	H	I	H	I	H	I	H	I	H	I	H	I	H	I	H	I	H
P.expansum	0.18	0.28	1.09	2.2	4.02	6.8	5.82	6.35	3.31	3.00	3.70	4.20	3.5	4.2	4.24	5.25	0.51	1.24
Botrytis cinerea	0.18	0.28	1.14	2.2	5.02	6.8	5.00	6.35	4.44	3.00	3.15	4.20	3.70	4.2	6.24	5.25	0.81	1.24
M.fructigena	0.11	0.28	0.19	2.2	7.24	6.8	6.78	6.35	10.00	3.00	7.12	4.20	3.52	4.2	7.38	5.25	0.51	1.24

Table-2: Biochemical changes in infected banana fruits.

Fungal Pathogens	Nitrogen(%)		Protein (%)		Total sugar(%)		Ascorbic acid(%)		Total phenol(%)		Reducing sugars(%)		Non reducing sugars(%)		Total free aminoacid(%)		Total ash(%)	
	I	H	I	H	I	H	I	H	I	H	I	H	I	H	I	H	I	H
Colletotrichum musae	0.18	0.25	1.21	3.20	12.04	15.5	5.22	2.45	3.12	1.14	10.08	11.82	7.05	11.08	3.40	7.54	1.00	1.84
Fusarium solani	0.19	0.25	0.27	3.20	12.00	15.5	3.45	2.45	3.26	1.14	9.24	11.82	10.22	9.08	9.22	7.54	1.11	1.84
T.roseum	0.15	0.25	1.17	3.20	11.4	15.5	2.45	4.14	3.45	1.14	6.32	11.82	8.05	11.08	8.65	7.54	0.24	1.84

Table-3: Biochemical changes in infected mango fruits.

Fungal Pathogens	Nitrogen(%)		Protein (%)		Total sugar(%)		Ascorbic acid(%)		Total phenol(%)		Reducing sugars(%)		Non reducing sugars(%)		Total free aminoacid(%)		Total ash(%)	
	I	H	I	H	I	H	I	H	I	H	I	H	I	H	I	H	I	H
C.gloeosporioides	0.38	0.50	0.78	1.14	9.08	10.05	4.34	7.00	4.00	3.00	10.12	11.26	4.34	6.24	4.30	2.76	1.19	2.00
A.niger	0.28	0.50	0.13	1.14	9.08	10.05	3.22	7.00	5.31	3.00	6.14	11.26	5.44	6.24	5.88	2.76	1.12	2.00
R.arrizus	0.28	0.50	1.35	1.14	7.00	10.05	9.25	7.00	5.34	3.00	6.36	11.26	9.55	6.24	5.16	2.76	1.12	2.00

DISCUSSION ON TABLES:

Fungi are the most common pathogens that cause apple, banana, and mango postharvest infections. In the tropics and subtropics, losses from postharvest illnesses are huge. With the importance of fruit in our diet in mind, efforts must be made to reduce losses so that at least 20% of our fruit production may be saved.

1. **Apple:** From the results shown in Table-1, it is obvious that the apple fruits infected with *P.expansum* reduced total sugar and increased reducing sugars in infected fruits. The amount of free and bound amino acids, organic acids, sugar, and vitamin C in the bloodstream varies as the disease advances.In fruits infected with *B.cinerea*, non-reducing sugars decreased more than reducing sugars.The reducing sugar content of apple fruits inoculated with *P. expansum, M. fructigena*, and *B.cinerea* reduced dramatically when the incubation duration was increased. Chaudharyet al(1980) findings are supported by their own study. Throughout the investigation, there was a large decrease

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in total fruits and a significant increase in reducing sugars in both healthy and sick apple fruits. The amount of free and bound amino acids, organic acids, sugar, and vitamin C changes as the disease progresses.A reduction in total sugars and vitamin C content of the apple fruits was seen as *M.fructigena* pathogenesis progressed. Non-reducing sugar was likewise significantly lower than reducing sugar.In apple fruits infected with *Rhizopus stolonifer*, Singh and Prashar (1981) discovered that the decrease in non-reducing sugar was greater than the fall in reducing sugar. On reduced the total ash content and increased the free amino acid concentration. All three viruses caused a significant increase in phenolic content in infected fruits when compared to controls.Schovankova and Opatova (2011) discovered that apples inoculated with *Monilinia fructigena* had a higher concentration of total phenols in the healthy pulp than around the rotten part of the apple. Nitrogen, protein, and total ash levels have all decreased.

2. **Banana:** The results shown in Table-2 show that non-reducing sugars have risen while total phenol has dropped. All have reduced nitrogen, protein, and ash amounts. The banana's total free amino acids and vitamin C content were altered by *A.niger* pathogenesis.The banana fruit infected with *Fusarium solani*, a fruit rot virus, had significantly altered nutritional content. Total sugar, Ascorbic acid, and free amino acid concentration were shown to be drastically reduced. Total phenols in blood increased. Total ash, nitrogen, and protein levels were lower than healthy fruits (Control).Banana fruits infected with *C. musae* contain more phenolic chemicals than normal.Banana fruits infected with the virus, on the other hand, had a significant rise in total phenols (Sawant and Gawai, 2011).Raghunathan et al. (1966) detected a comparable increase in phenol content in bananas shortly after the researchers discovered a fungus infection with *G.musarum*. It began to drop after 68 hours, finally becoming undetectable. In the absence of fruit rot, non-reducing sugars rose. All five banana cultivars suffer from *R.oryzae* infection, reducing nitrogen, protein, and total ash.According to Coursey and Booth (1972), one-third of all banana yield is lost due to postharvest degradation.Wardlaw (1972) discovered and tracked down the source of infection for the majority of the main post-harvest diseases in banana farms. Srivastava and colleagues (1965) discovered that common banana fruit rot fungi such as *C. musae*, *B. theobromae*, and *Alternaria alternata* are frequently detected in conjunction with banana plant leaf spot lesions in orchards.

3. **Mango:***C.gloeosporioides* caused biochemical changes in mango fruits. The increase in non-reducing sugars in infected mango (var. Dasheri) fruits was notable since total sugar and ascorbic acid levels decreased.According to Ghosh et al. (1966), after 10 days of incubation with *Aspergillus niger*, the ascorbic acid content of mango fruits of the cultivars Dasheri and Langra that had been infected with the fungus decreased. After 7 days, there was no vitamin C left. Mango fruits had an increase in total free amino acids. Total phenols, reducing sugars, and non-reducing sugars were all shown to be greater in this study. Total ash, nitrogen, and protein levels decreased significantly.Ghosh and colleagues (1965) discovered that when mature mango fruits of the cv. Dasheri cultivar are stored for a long time, the sugar content increases slightly.The findings show that healthy mango fruits have a higher nutritional value than defective mango fruits. Mango fruits infected with *A.niger* had more free amino acids but less sugar. The concentration of total phenols, non-reducing sugars, and reducing sugars increased. However, nitrogen, total ash, and protein contents all decreased. The results show that *R.arrizus*-infected mango fruits have greater total phenol, non-reducing sugars, and reducing sugars. The product's ash and vitamin C content were also

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reduced. Postinfection levels of nitrogen, protein, and total sugar were also reduced. Srivastava and Tandon (1966) discovered that B. theobromae infection of mango fruit tissue resulted in a decrease in vitamin C concentration in the mango fruit tissue.However, total free amino acid was found to be greater.Several researchers have identified changes in the reducing sugar content of mangoes infected with *Aspergillus niger*, including Pandey et al. (1991), Fuchs et al. (1980), Tandon (1970), Reddy and Laxminarayana (1984). The mango fruits were found to be completely devoid of vitamin C after seven days of infection with *Colletotrichumgloeosporioides*. Rai, R. N. (1982), and others have gotten essentially comparable results.According to Singh (1960), the harvesting of the mango crop in India has experienced a 40% loss in yield.When infected mangoes were placed at room temperature, normal development was restored in the plant, according to Eckert and Sommer (1967).Srivastava et al. (1965) conducted a survey of mango markets in several parts of India and discovered that postharvest losses in mango types owing to Aspergillus rot ranged from 4.0 to 35%, *Colletotrichum* rot from 5.0 to 15%, and *Botryodiplodia* rot from 6.5 to 20%.

CONCLUSION

The significant deterioration of stored fruits and vegetables that happens during storage and transit is caused by a variety of storage fungus. After harvest losses from perishable fresh fruits and vegetables are significantly more difficult to recover than losses from grains and other field crops.It is concluded from the above investigation that the significant biochemical changes in apple, banana and mango fruits discussed here clearly demonstrated that the significant biochemical changes reduced the nutritive value of apple, banana and mango fruits, ultimately rendering them unfit for human consumption and reducing their market value.

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