SURVEY OF FUNGI IN FOODSTUFFS STORED IN ASC WAREHOUSES IN ASSAM REGION

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The paper describes the isolation and characterisation of various fungi present in common foodstuffs stored in Army warehouses located in hot humid climate of Assam. Fungal contamination in the food commodities is highest in the rainy season and lowest in winter. Among the fungi isolated, *Aspergillus niger, A. Fumigatus, Rhizopus nigricans* and species of *Mucor* and *Penicillium* were found in all the samples analysed. Amongst these, members of *Aspergillus* dominated in the rainy season and *Penicillium. Rhizopus nigricans* was predominant in the winter months.

Foodstuffs such as wheat, wheat flour, rice and different types of pulses are stored by the Army in ASC depots for issue to troops. These foodstuffs often harbour a large number of fungal spores and under certain conditions of storage, some of them could grow and bring about spoilage. In addition some produce mycotoxins many of which are known to be potent carcinogens. Some of them are heat stable and are not destroyed by the normal cooking. Occurrence of mycotoxins as contaminants in foods and their raw materials is widely reported[1—5]. The climate prevalent in Assam with major portion of the year having an average temperature of 30°C, 225 mm rainfall and 82% RH is highly conducive for the growth of storage fungi. Since no data is available regarding the type of fungi present in the food commodities stored in the Service depots located in this region, the present work was undertaken. The paper reports the isolation, characterisation and distribution of various fungi occurring in these commodities.

MATERIALS AND METHODS

Three depots, henceforth referred to as Depots I, II and III were selected for the studies. Samples of wheat, wheat flour, rice and various pulses viz., *Moong Dal* (green gram, *Phaseolus oreus*), *Urad dal* (Black gram, *Phaseolus mungo*), *Chana Dal* (Bengal gram, *Cicer arietinum*). *Masoor dal* (Lentil, *Lens culinaris*) and *Arhar dal* (Red gram, *Cajanas cajan*) were collected from these ASC depots in different seasons viz., rainy (May to September), winter (Oct. to Jan.) and summer season (Feb. to Apr.). The samples were collected by random sampling method in the months of July, December and March, which were taken as the representative months for the above seasons. The samples were taken in 0·5 and 1 kg quantities in triplicate, packaged in polythene bags and brought to the laboratory. The whole grains were made into a powder using an electric mixer under sterile conditions whereas flours were used as such for dilutions. Serial dilutions were made in one fourth Ringer's solution. These were further analysed for the moulds as per standard methods[6]. Identification was done in accordance with the procedure of Gilman[7] and Barnett[8].

RESULTS AND DISCUSSION

The results of the mycological survey are summarised in Table 1. Wherever the total number of fungi present were less than 100 they were considered as negligible and not included in the table. Rice samples collected in summer and winter from Depot I; *Urad dal* (*Phaseolus mungo*) collected in summer and wheat in winter from Depot II, and rice, *chana dal* (*Cicer arietinum*) and wheat collected in summer and *Urad dal* in winter from Depot III were found to belong to this group. Similarly some of the fungi were present only in few cases and hence not included in the table.

TABLE 1

FUNGI ISOLATED FROM FOOD COMMODITIES IN VARIOUS DEPOTS DURING DIFFERENT SEASONS

FOOD commodity	Season	Source (Depot No.)	Degree of contamination No./g	Moulds identified % distribution							
				Af	*An*	A_1	A_2	P_1	P_2	*Rn*	M_1
Atta	Winter	I	285	70	—	—	—	5·2	—	10·5	—
	,,	II	1000	—	—	—	—	—	20	80	—
	,,	III	150	33·3	—	—	—	66·7	—	—	—
	Summer	I	400	—	—	—	—	25	25	50	—
	,,	II	1000	—	10	—	—	30	20	—	20
	,,	III	210	—	23	—	7·9	52·4	—	16·7	—
	Rainy	II	960	—	34·4	—	—	36·3	—	14	—
		III	1800	28	16·5	—	—	—	—	55·5	—
Wheat	Winter	III	500	40	—	—	—	—	40	—	20
	Rainy	II	900	—	33·3	—	—	66·7	—	—	—
	,,	III	600	—	66·6	—	—	33·4	—	—	—
Sooji	Winter	I	700	—	—	—	—	—	—	100	—
	,,	II	1800	—	—	10·7	—	6	—	83·3	—
	,,	III	100	—	70	—	—	—	—	30	—
	Summer	II	1200	—	—	—	17	—	—	50	—
	,,	III	300	23	26	—	18	—	—	33	—
	Rainy	I	180	16·6	16·6	16·6	—	—	—	—	—
Rice	Winter	II	2200	—	—	—	—	—	—	45·4	45·4
		III	220	32	36·3	—	—	—	13·7	18	—
	Summer	II	150	—	—	—	14	40	14	—	13·5
	Rainy	II	26000	—	2	—	—	—	—	38	2·3
	,,	III	7700	—	80	6·5	—	—	—	—	13·5
Dal Moong	Winter	I	430	67·4	7	—	—	—	—	23·2	—
	,,	III	800	—	37·5	—	—	25	—	37·5	—
	Summer	I	140	—	21	36	—	—	—	43	—
	,,	III	250	32	—	—	—	—	—	48	—
	Rainy	I	176000	—	14·8	—	—	68·2	—	—	17
		III	6500	77	4·6	12·4	—	—	—	—	6
Dal Urad	Winter	I	1300	11·6	54	—	—	—	—	26·6	—
	Summer	III	1400	—	7	—	57	—	14·3	—	—
	Rainy	I	12000	—	—	—	—	43·3	56·7	—	—
	,,	II	190	31	—	—	—	—	21	22	—
	,,	III	100	10·5	—	—	—	15·8	—	—	—

TABLE 1—*contd.*

1	2	3	4	5	6	7	8	9	10	11	12
Dal Chana	Winter	II	3100	—	—	—	—	32·3	—	64·5	—
	,,	III	150	26·7	53·3	—	—	—	—	20	—
	Summer	I	400	—	25	—	—	—	—	75	—
	,,	II	100	—	—	—	20	—	20	50	—
	Rainy	III	69000	75·3	—	24·7	—	—	—	—	—
Dal Masoor	Winter	II	690	—	—	—	—	97	—	1·5	1·5
	,,	III	240	—	75	—	—	—	—	25	—
	Rainy	III	206000	72·8	12	5·5	9·7	—	—	—	—
Dal Arhar	Winter	II	2600	—	—	—	—	23	—	57·7	19·3
	Summer	III	130	—	61·6	—	—	—	—	38·4	—
	Rainy	III	10700	80	—	4·5	—	—	—	—	13·5
Bason	Winter	I	300	—	66·6	—	—	—	33·4	—	—
	Summer	I	200	30	—	—	—	—	—	50	—
	Rainy	I	220	—	36	—	—	45	9	5	—

Af—*Aspergillus fumigatus*, *An*—*Aspergillus niger*, A_1—*Aspergillus* sp_1, A_2—*Aspergillus* sp_2, P_1—*Penicillium* sp_1, P_2—*Penicillium* sp_2, *Rn*—*Rhizopus nigricans*, M_1—*Mucor* sp_1, ,— —*Absent*

A perusal of the table shows that there is a lot of variation in the degree and type of contamination from depot to depot and from season to season. The total fungal contamination was always found to be highest as expected, in the rainy season. *Aspergillus niger*, *Aspergillus fumigatus*, *Rhizopus, nigricans* and species of *Mucor* and *Penicillium* were found in all the samples analysed. Amongst these, members of *Aspergillus* dominated in the rainy season this was followed by *Penicillium*. *Rhizopus nigricans* was predominant in the winter months. In addition to these *Trichoderma* sp, *Paecilomyces* sp, *Fusarium* sp and *Mucor* sp were also present some of the samples in smaller numbers. *Fusarium* sp wherever present was mostly in pulses particularly in *Urad dal*. It is to be investigated whether there is any significance to this observation with the metabolism of the fungus.

Certain *Fusarium* strains are known to elaborate mycotoxins in the substrates on which they grow and ingestion of such foodstuffs has been reported to cause severe disorders in the system. Similarly some of the other fungi isolated like *Aspergillus ochraceous*, *Aspergillus* sp, *Aspergillus fumigatus*, *Penicillium* sp etc. are known to be capable of producing mycotoxins in foods and feeds in the presence of adequate moisture and appropriate temperature. However, in our present studies *A. flavus* was isolated from one sample of sooji taken during rainy season from Depot I and in *atta* samples during summer from Depot II and *A. ochraceous* was isolated from *urad dal* sample of Depot III. Some of the fungi were present only in small numbers in a few of the samples. These were *Syncephalastrum* sp, *Paecilomyces* sp., *Curvularia* sp, *Trichoderma* sp and one sp of *Penicillium*. Shank et al[9,10] found that the frequency and extent of contamination showed a seasonal trend being the highest in the rainy season and lowest in hot season. However, in the present investigation while highest contamination was found in the rainy season, the lowest was in the winter season. As relative humidity or the water activity of the substratum is the predominant factor responsible for fungus growth, the least growth could be expected of during the winter only. Perhaps, in the areas studied by Shank *et. al.*, the relative humidity may have been least in hot season in the year they studied.

Shank, Wogan and Gordan[10] while surveying foods and foodstuffs for occurrence of toxigenic mould in Thailand and Hongkong recorded their presence in 34% of the samples. By contrast in the present investigation among 59 samples studied, *Aspergillus flavus* were detected in 3, *A. fumigatus* in 17, *A. ochraceus* in 1 and *Fusarium* in 3 only. It remains to be investigated to what extent is the potential for toxin production realised or if at all the toxins are produced to what extent they are destroyed in the normal cooking to get an idea of the quantity likely to be actually consumed by the user. Work in this direction has been initiated and will be the subject of a future communication.

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