BIOCHEMICAL AND NUTRITIONAL INVESTIGATION ON EAST PAKISTAN RICE AND RICE PRODUCTS

Part IV.—Differential Moisture Absorption by Raw and Parboiled Paddy and Rice

H. N. DE AND M.A. REZA ALI

Nutrition and Physics Sections, East Regional Laboratories, Pakistan Council of Scientific and Industrial Research, Dacca

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Introduction

In previous communications reported from these Laboratories[1,2] it has been shown that partial inactivation of amylase of the paddy, and esterase group of enzymes during parboiling treatment, is responsible for the longer storage life of the parboiled rice.

The enzyme activity depends on the temperature, initial moisture level and the moisture absorption during storage. The relationship between natural humidity, moisture absorption and enzymatic activities, and their overall effect to cause damage to the cereal like wheat during storage have been extensively studied by several workers.[3-12] Recently some work has been started with rough (raw) rice to study similar aspects of storage under different humidity conditions.[13,14] No work of this type has so far been carried out with parboiled rice. It was, therefore, considered worthwhile to make a comparative study of the absorption of moisture by the parboiled and raw paddy and their rice under storage in the natural atmospheric conditions of this region.

Experimental

Paddy samples collected from the Government Agricultural Farm, Dacca were selected for the present investigation. One batch of the paddy was parboiled according to the traditional techniques described in the previous communications from these Laboratories by Qudrat-i-Khuda, De and their associates[1,2] and another batch was kept as raw without any processing operation. Both the raw and the parboiled paddy were dried under the sun and portion of the batches were then dehusked by hand process. Specimen samples of raw and parboiled paddy and their rice were then stored under natural atmospheric condition in small hessian bags in the laboratories.

Determination of Equilibrium Moisture Contents.—The stored samples were subjected to the determination of their equilibrium moisture contents at regular intervals, from the beginning of storage, with the help of Infrared Moisture Meter calibrated for measurement of moisture upto 100 percent with an accuracy of 0.1 percent. The determinations were made on lots of 10 g. sample under a constant radiation temperature of 105°C. The Zero moisture percent reading of the meter was first calibrated with the help of standard weight of 10 g. and frequent checking of this Zero percent reading was made at regular intervals.

The Relative humidity and the temperature were daily recorded by the automatic Thermohygrograph and the atmospheric pressure from the Barograph, although last values were however, not taken into consideration in the present investigation.

Each lot of the sample took nearly three hours to record the constant moisture percent in the meter and by this time, in some cases the RH varied to a certain extent. In such cases the RH values for the above period of estimation was averaged.

The results of the equilibrium moisture contents against the different RH and temperatures of a typical sample of medium size grain 'Dular' are represented graphically by Fig. 1. Because of a long time required for each measurement it was not possible to determine the moisture contents of four sample viz raw and parboiled paddy and rice on the same day under identical conditions of RH but this can be assessed and deduced from the curve by extrapolation against a particular RH value.

Results

The results showed that during dry hot season in the month of April, the RH remains in the range of 44 to 55 percent and at this range of RH, equilibrium moisture contents of paddy and rice remain also low—the values being 9.7 and 11.0 percent, respectively for raw rice and paddy and 7.7 and 8.8, respectively for parboiled paddy and rice. With the advent of monsoon the RH gradually increased until reached to the highest level of 90 percent in the month of July. Equilibrium moisture contents under such humidity conditions showed gradual increase until reached to a maximum level at a critical RH which is dependent on the nature of the material. The maximum equilibrium moisture contents for the

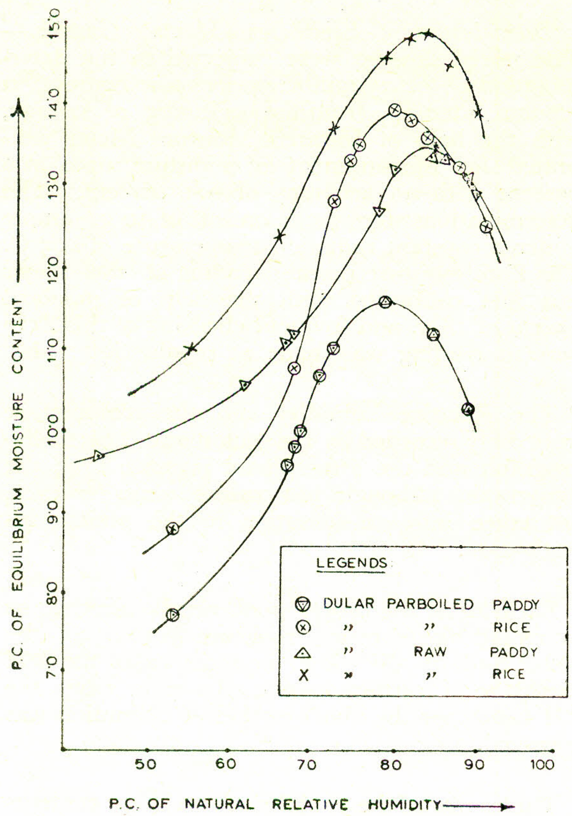

Fig. 1.

raw paddy and rice were recorded as 13.3 and 14.9 percent respectively at the critical RH Peak level of 84 percent and for the parboiled samples the values for paddy and rice were 11.2 and 13.8 percent, respectively at the lower range of the RH peak level of 80 percent. Beyond these critical RH peak levels there was decrease of the equilibrium moisture contents and this indicates that the rice grains possess limited capacity for holding up the environmental moisture and that this capacity is reversed leading to desorption of the moisture when the RH passes beyond the critical peak levels. This capacity is more for the raw samples than for the parboiled ones. Moreover, comparatively the capacity is less for paddy than for rice under both raw and parboiled conditions.

Discussion

The lower absorption of moisture by parboiled paddy and rice is one of the causative factors for decreased activity of amylase, esterase etc. as previously reported from these laboratories.[1,2] This assists in extending their storage life by diminishing the production of sugar, fatty acids etc. which are the necessary constituents for the growth of microorganism and infestation by insects etc. to cause fermentation, rancidity and off-odour production. The differential moisture absorption by raw and parboiled paddy and rice in relation to the infestation by insects etc. is now being investigated to standardise the RH condition for satisfactory storage of these products in this region.

The less moisture absorption by the parboiled sample may be due to partial dextrinisation of the starch granules forming a hard coat on the endosperm which, however, retards the moisture absorption when exposed to humid atmosphere.

Less moisture absorption by paddy—both raw and parboiled—is due to low hygroscopicity of the husk which ultimately aids to their longer storage life. These findings are complimentary to the views of FAO[15] that the storage of rice in the form of paddy is preferable.

The common belief among the housewives of this region that the parboiled rice yield more meal after cooking than the raw one is partly due to availability of more dry solid material from the parboiled rice because of its less moisture content per unit weight.

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NUTRITIVE VALUE OF EDIBLE WILD PLANTS IN THE FRONTIER REGION OF WEST PAKISTAN

A.K. BALOCH AND S. HUJJATULLAH

North Regional Laboratories, Pakistan Council of Scientific and Industrial Research, Peshawar

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Introduction

In most parts of West Pakistan as in other tropical or sub-tropical areas, many plants of considerable nutritive value are not fully utilised. A gene:al survey of the dietry habits of the people belonging to the former N.W.F.P., however, revealed that certain wild plants growing abundantly in the area and available free of cost constitute an important item of their daily food. Such vegetable materials include tubers, legumes and leaves cooked or used as salad and also some raw fruits cooked or utilised in the form of pickles. The edible portions of the plants are acceptable to the consumers upto a certain stage of maturity. Leaves, for instance, become unacceptable when the leafy plants bear seeds. Leafy plants are available in large quantities and are very popular among the people of this region. As no information regarding the nutritive value of these vegetable products is available a thorough investigation of their chemical composition to assess their nutritional value was considered necessary.

Twenty varieties have been studied because of their popularity. Mode of consumption of these plants has also been reported. Analysis of ash and percentage of Vitamin C and provitamin 'A' have been given in separate tables.

Studies on the amino acid composition of these proteins have been undertaken by the authors.

Materials and Method

The material for investigation was collected from the fields before or at the flowering stage when their acceptibility was maximum. The analysis was started immediately after arrival of the samples in the laboratory. The samples were prepared by washing and removing water by blotting paper and then chopping in a multimixer. Weighing was quickly followed so as to reduce the error by loss of water.

All samples were analysed for moisture, nitrogen, ether extract, crude fibre, ash contents and calcium by the A.O.A.C. Methods of analysis,[1] for iron and β-carotene by methods of Winton[2] and phosphorus by the micro method given by Jacobs.[3] Total and available carbohydrates were calculated by difference. Calorific values were obtained by the sum of the fuel values of carbohydrates, proteins and fat present in a particular sample. Vitamin A equivalent of β-carotene was determined by the formula, i.u. of Vitamin A $\equiv 0.6 \mu g$ of β-carotene.

In addition to the determination of phosphorus, iron and calcium, ash samples were also analysed for water insoluble and acid insoluble portions and total alkalinity in order to establish the nature of the ash.

Attempts have been made to collect the best representative samples for the analysis by collecting the various plants little by little from diverse areas and heeping upto a large amount (15-20 lbs.) and then picking up the desired amount for further treatment. The results reported in Tables 1,2 and 3 have been arrived at by finding the mean of five determinations in case of protein and three in case of all other values.

Results and Discussion

The proximate chemical composition and mode of consumption of the plants studied are shown in Table 1. These results are the typical ones for the actual consumer. Moisture contents are between 75 and 89 percent for leaves, slightly lower for "Daila" fruit and very low for 'Ispghole' husk which is obtained almost dry from the barren fields and consumed as such.

TABLE 1.—PROXIMATE ANALYSIS OF THE EDIBLE WILD PLANTS.

Sr. No.	Local name	Botanical name	Edible portion	Moisture %	Protein %	Ether extract %	Ash %	Carbohydrates			Calorific value per 100 gm.	Mode of consumption
								Total %	Fibre %	Available %		
1.	Paishtarey	Medicago denticulata	Leaves and flowers	78.5	6.9	1.09	2.4	11.11	1.3	9.81	77	Cooked
2.	Pandeyrakh	Malva montana	Leaves and seeds	78.9	8.7	0.90	3.3	8.20	1.04	7.16	71	,,
3.	Ganhar	Amaranthus blitum	Leaves and flowers	74.7	8.1	0.30	4.5	12.40	0.70	11.70	82	,,
4.	Chalkhey	Rumex dentatus	Leaves	89.3	3.5	0.45	2.0	4.75	0.67	4.08	34	,,
5.	Kachmachu	Solanum nigrum	Leaves and flowers	8.5	5.5	0.65	3.5	9.85	0.40	9.45	66	,,
6.	Batho	Chinopodium album	Leaves and flowers	85.8	2.7	0.38	2.6	8.50	0.30	8.20	47	,,
7.	Bashka	Lepidium sativum	Leaves	86.0	6.0	1.00	2.5	4.50	1.10	3.40	47	,,
8.	Kajberey	Tarixicum officinalis	Leaves and flowers	88.8	3.6	1.60	2.3	3.70	0.44	3.26	42	,,
9.	Shaftal	Trifolium resipanatum	Leaves	80.3	7.2	0.80	1.7	10.00	0.96	9.04	72	,,
10.	Khub Kalan	Sisymbrium irio	Leaves	81.5	7.0	1.2	2.6	7.7	0.39	7.31	68	Raw or cooked
11.	Liveney	Medicago hispida	Leaves and flowers	80.8	8.5	1.08	1.87	7.75	1.02	6.73	71	Cooked
12.	Tirwakey	Oxalus corniculatus	Leaves	85.5	5.1	0.65	1.20	7.55	0.17	7.38	56	Raw or cooked
13.	Kachnar	Bauchinia variegeta	Legumes	75.0	5.2	0.40	1.80	17.60	2.80	14.80	84	Cooked
14.	Daila	Capparis aphylla	Fruits	70.1	5.9	1.23	1.90	20.87	4.60	16.27	100	Pickled or cooked
15.	Josaga	Chinopodium morale	Leaves	76.2	6.3	1.10	5.20	11.20	0.56	10.64	78	Cooked
16.	Injeer	Ficus palmata	Fruits	83.5	2.9	2.90	1.17	9.50	1.70	7.80	69	Pickled or cooked
17.	Podina jangli	Mentha sylvestris	Leaves	80.7	4.6	1.60	4.80	8.30	1.80	6.50	59	Raw or cooked
18.	Ispghole	Plantago psyllium	Husk	8.30	1.4	3.40	1.98	84.90	0.35	84.55	374	Raw or cooked
19.	Walkharey	Portulaca obraceae	Leaves and flowers	88.6	2.1	0.78	2.1	6.42	0.70	5.72	38	Raw or cooked
20.	Bagri	—	Seeds	67.6	4.2	0.6	1.2	26.4	1.95	24.45	120.0	Cooked

Crude fibre falls within the expected range except for the "Daila" fruit wherein the stony seeds are included and so the cellulosic portion is increased as much as 4.6 percent. Fat percentage (ether extract) of the various samples is also within reported limits. A slightly higher figures for Ispghole and Injeer fruit are normal with respect to the nature of the material.

What seems most significant among the analytical data of these agricultural products, is the high percentage of proteins. For most of the leafy plants the range is above 5.0 percent, the lowest being 2.7 and the highest 8.7 on fresh weight bases. On dry weight bases this goes upto as high as 41 percent. Evidently these food articles provide a rich source of protein so much so that

TABLE 2.—ANYLYSIS OF ASH.

Sr. No.	Name	Water soluble ash %	Alkalinity* of the ash %	Water in-soluble ash %	Acid soluble ash %	Acid in-soluble %	Minerals contents mg./100g. fresh vegetable		
							Phosphorus	Calcium	Iron
1.	Paishtarey ..	0.86	35.8	1.54	0.797	0.743	43.4	521.7	4.6
2.	Pandeyrakh ..	1.95	62.5	1.35	1.232	0.118	178.2	686.8	5.0
3.	Ganhar ..	2.13	47.2	2.39	1.730	0.817	102.7	837.5	13.0
4.	Chalkhey ..	1.41	62.7	0.59	0.512	0.078	53.8	611.5	3.4
5.	Kachmachu ..	1.326	9.6	2.174	2.006	0.168	46.8	307.4	6.6
6.	Batho ..	1.3	90.6	1.3	1.225	0.075	30.0	182.5	1.4
7.	Bashka ..	1.85	9.2	0.65	0.405	0.245	45.0	297.3	2.5
8.	Kajberey ..	0.07	36.5	2.23	1.96	0.27	59.1	473.5	3.3
9.	Shaftal ..	0.8	32.8	0.9	0.475	0.425	61.2	505.4	6.1
10.	Khub Kalan ..	1.32	59.3	1.28	1.205	0.075	125.0	485.0	2.5
11.	Liveney ..	1.0	41.8	0.87	0.79	0.08	66.5	377.2	2.1
12.	Tirwakey ..	1.142	31.8	0.058	0.006	0.052	88.2	352.4	5.2
13.	Kachnar ..	0.97	52.5	0.83	0.745	0.086	95.3	294.3	2.9
14.	Daila ..	1.777	16.2	0.272	0.247	0.025	50.8	153.8	2.0
15.	Josaga ..	3.06	199.6	2.14	1.931	0.209	65.5	737.2	4.6
16.	Injeer ..	0.545	39.2	0.625	0.552	0.072	46.6	280.0	4.1
17.	Podina jangli ..	3.077	87.6	1.723	1.263	0.46	333.9	691.7	27.4
18.	Ispghol ..	1.644	99.5	0.336	0.285	0.051	57.8	305.9	18.3
19.	Walkharey ..	1.19	86.4	0.91	0.817	0.093	39.8	296.9	1.7
20.	Bagri ..	0.995	15.8	0.205	0.1983	0.0067	300.0	62.0	1.1

*Expressed by the number of milliliters of decinormal acid per 100 g. of the sample.

TABLE 3.—CONTENT OF VITAMIN C AND PROVITAMIN A IN THE PLANTS.

No.	Name	Vit. C mg./100 g.	β-carotene μg/100g.	Vit. A potency i.u.
1.	Paishtarey	187	5600	9300
2.	Panday Rakh	197	8800	14700
3.	Ganhar	211	4800	8000
4.	Chalkhey	115	7000	11700
5.	Kachmachu	140	4800	8000
6.	Batho	97	240	400
7.	Bashka	72	5000	8300
8.	Kajberey	73	4020	6700
9.	Shaftal	163	2400	4000
10.	Khub kalan	176	6000	10000
11.	Liveney	128	4700	7800
12.	Tirwakey	229	2800	4600
13.	Kachnar	176	6600	11000
14.	Daila	35	8600	14300
15.	Jusaga	149.6	5800	9600
16.	Injeer	40	9000	15000
17.	Podina jungly	70	27000	45000
18.	Ispghole	00	2460	4000
19.	Walkharey	66	9500	16000

they can be exploited in meeting protein deficiency in the diet of common man. It may be added here that leaf proteins have been reported to yield a reasonable amount of essential amino acids including lysin.[4]

Still another figure in Table 1 that may seem unusual is the ash contents of these edibles. This, value is particularly very high for Jusaga (5.2%), podina jangli (4.0%) and Ganhar (4.5%), but the case of Pandeyrakh and Mako is also not less uncommon. Such a high percentage of ash has scarcely ever been reported for vegetable foods. It was, therefore, considered necessary to investigate the nature of the ash material obtained from these plants. The results of this analysis have been reported in Table 2.

The data in Table 2 is a measure of justification for the unusual ash values reported in Table 1. In general the mineral contents of almost all the samples are high as compared with the early reports on such type of materials. This is particularly so in case of calcium which goes up to 837 mg./100 g. fresh weight for Ganhar along with

13 mg. iron and 103 mg. phosphorus. Next to Ganhar the amount of calcium is the highest (737.2 mg.) in Jusaga which also yields a highly alkaline ash. Iron and phosphorus contents are the highest in Jangli podina which gives 4.8% ash. Similarly the figures in all the values tabulated therein may be correlated.

Vitamin C and β-carotene contents of these materials have been presented in Table 3. Generally they are all good sources of ascorbic acid. Some of these are consumed raw and therefore, provide a reasonable amount of vitamin C in daily diet. Carotenes are high in most of the samples, anticipating a rich supply of Vitamin A to consumers.

Conclusion

Twenty of the edible wild plants in Peshawar Region have been analysed for their nutritive value. In addition to moisture, crude fibre, protein, ether extract and ash, phosphorus calcium and iron, Vitamin C and β-carotene has also been determined. Most of them are good sources of proteins, minerals, ascorbic acid and pro-vitamin A. The results provide useful information about the nutritional status of the people residing in this area.

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FUNGUS FLORA OF LAHORE SOILS

MAHBOOB ALAM QURESHI

West Regional Laboratories, Pakistan Council of Scientific and Industrial Research, Lahore

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Introduction

Soil is inhabited by micro-organisms including viruses and in this habitat fungi constitute a significant group. Soil fungi live on dead organic matters and in this way help to release the essential elements required for the growth of crop plants in the fields. Some of the soil fungi like *Penicillium sp.* have been isolated and employed for the production of penicillin. Most of these studies have been carried out in other countries and the informations about the fungi occurring in Pakistan soils is rather scanty. In India, Butler[1] gave an account of the genus *Pythium* and some Chytridiaceae inhabiting the soil. Chaudhuri and Sacchar[2] described 32 species of fungi isolated from Lahore soils. Later, Hukam Chand[3] reported 86 fungi inhabiting Lahore soils. Since then no definite work has been carried out in this field. It was therefore felt that a systematic study of Fungi of Lahore area be conducted.

Materials and Methods

For isolating soil fungi the Czapek's Dox agar [4,6] and Peptone dextrose medium[5] were used. Rose bengal and Streptomycin were also used in culture.

Soil Sampling.—Soil samples were taken from the West Regional Laboratories area. This soil is a light loam with a fair quantity of silt and organic matter. Two plots—a corn field and a grassy plot were selected. The upper surface layer up to a depth of one inch was removed. A pit 12″ deep was dug, the samples were taken by inserting the sterilized tubes horizontally at 3″, 6″, 9″ and 12″ depths from one side of the pit.

Isolation of Fungi.—The isolation was made on the same day by Soil Plate Method.[8] About 0.01 g. of soil sample was transferred by means of a nichrome microspatula to each Petridish. A small amount of sterilized water was added to disperse soil particles. 12-15 ml. of sterile agar medium was added to each dish. The plates were rotated gently for uniform dispersal of particles. Four plates of each samples were inoculated in both the media.

The plates were incubated at 28°C. for 7 days. After 7 days the colonies were counted. Individual colonies were isolated and subcultured. Morphological studies were carried out for preliminary identification. All the cultures were later on sent to Commonwealth Mycological Institute, Kew Garden, Surrey, England, for further identification and confirmation.

Results and Discussion

The following fungi have been isolated and identified from samples of soils from Lahore region: (1) *Alternaria stemphylioides* Bliss., (2) *A. tenuis* Nees expers., (3) *Aspergillus awamori* Nak., (4) *A. candidus* Link., (5) *A. chevalieri* (Mong) Thom & Church., (6) *A. flavipes* (Bain & Sart) Thom & Church., (7) *A. flavus* Link., (8) *A. luchuensis* Inui., (9) *A. nidulans* (Eid) *Wint.*, (10) *A. niger* Van Tiegh., (11) *A. restrictus* Smith., (12) *A. ruber* Thom & Church., (13) *A. sulphureus* Fres., (14) *A. sydowi* (Bain & Sart) Thom & Church., (15) *A. Tamarii* Kita., (16) *A. terreus* Thom., (17) *A. ustus* (Bain) Thom & Church., (18) *A. wentii* Wehmer., (19) *Chaetomium sp.*,*(20) *Cladosporium Cladosporioides* (Fresen) De Vries., (21) *Cladosporium sp.*,* (22) *Cunninghamella echinata* (Thaxt.) Thaxt., (23) *Curvularia lunata* (Waker) Boedijn., (24) *C. pallescence* Boedijn., (25) *C. spicifera* (Bainier) Boedijn., (26) *C. verruculosa* Tandon & Bilgrami., (27) *Curvularia sp.*,* (28) *Cylindrocarpon heteronemum* (Berk & Br.) Wr., (29) *C. radicicola* Wr., (30) *Epicoccum nigrum* Link, (31) *Fusarium oxysporium* Schlecht Ex Fr., (32) *F. sambucinum* Fuckel., (33) *F. salani* (Marl.) Sacc., (34) *Geotrichum candidum* (Link)., (35) *Helminthosporium halodes* Drechsler., (36) *H. hawaiiense* Bugnicourt., (37) *Mucor globosum* Fischer., (38) *Myrothecium striatisporum* Preston., (39) *M. verrucaria* Ditmar Ex Fr., (40) *Neocosmospora vasinfecta* Smith., (41) *Paecilomycis fusisporus* Saksena., (42) *P. variotii* Bain., (43) *Penicillium citrinum* Thom., (44) *P. expansum* Link., (45) *P. janthenellum* Biourge., (46) *P. lilacinum* Thom., (47) *P. rubrum* Stoll., (48) *P. spinulosum* Thom., (49) *P. sublateritium* Biourge., (50) *P. vinaceum* Gilman & Abott.,(51) *Penicillium sp.*,* (52) *Pestalotiopsis sp.*,* (53) *Pseudeurotium ovalis* Stolk., (54) *Phoma sp.*,* (55) *Pythium sp.*,* (56) *Rhinocladiella sp.*,* (57) *Scopulariopsis sp.*,* (58) *Stachybotrys arata* Corda., (59) *Syncephalastrum recemosum* Cohn ex Schroeter., (60) *Stysnus sp.*,* (61) *Trichoderma Koningii* oud., (62) *T. viride* Pers. ex Fr., (63) *Trichurus spiralis* Hasselbring.

In Peptone medium the number of fungal colonies were greater than in Czapek's Dox agar. In cornfield, the colonies of fungi on Czapek's Dox agar were 15, 14, 15 and 5 at 3″, 6″, 9″ and 12″ depths of soil respectively, while in case of Peptone medium the numbers were 18, 16,15 and 12 at 3″, 6″, 9″ and 12″ depths of soil, respectively. Similarly, in grassy plot the colonies of fungi isolated on Czapek's Dox agar from the depth of 3″, 6″, 9″ and 12″ of soil were 17, 16, 12, 16, while on Peptone medium they were 21, 20, 18, 17 at 3″, 6″, 9″ and 12″ depths of soil respectively. It appears from Table 1 that the suppression of bac-

TABLE. 1—NUMBER OF FUNGAL AND BACTERIAL COLONIES ON DIFFERENT MEDIA.

No.	Sample of soil from depth		Corn field: Czapek's Dox Agar: Fungal colonies	Corn field: Czapek's Dox Agar: Bacterial colonies	Corn field: Peptone Dextrose Medium: Fungal colonies	Corn field: Peptone Dextrose Medium: Bacterial colonies	Grassy plot: Czapek's Dox Agar: Fungal colonies	Grassy plot: Czapek's Dox Agar: Bacterial colonies	Grassy plot: Peptone Dextrose Medium: Fungal colonies	Grassy plot: Peptone Dextrose Medium: Bacterial colonies
1	3″	Total No. of colonies	60	17	70	Nil	68	24	84	Nil
		Average No. of colonies	15	5	18	,,	17	6	21	,,
2	6″	Total No. of colonies	55	7	64	,,	62	17	78	1
		Average No. of colonies	14	2	16	,,	16	4	20	Nil
3	9″	Total No. of colonies	58	14	60	,,	48	15	71	,,
		Average No. of colonies	15	4	15	,,	12	4	18	,,
4	12″	Total No. of colonies	19	11	49	,,	62	24	68	,,
		Average No. of colonies	5	3	12	,,	16	6	17	,,

* Not identified further.

terial growth takes place when rose bengal and streptomycin were added as also reported by Martin.[5] This decrease resulted in an increase in the number of fungal colonies.

The results reported in Table 1 also showed a gradual decrease in the number of fungi on Peptone Dextrose medium as reported by Waksman.[7] In corn field, on Peptone Dextrose agar, the decrease in the numbers of fungal colonies was 18 to 12 from the depth of 3″ to 12″, respectively. Similarly in case of grassy plot, the numbers decreased from 21 to 17 at the depth of 3″ to 12″ respectively. However, a different pattern was observed when Czapek's agar was used. In case of corn-field, on Czapek's Dox agar the number of fungi at the depth of 3″ was 15 and decreased to 14 when soil sample was collected from a depth of 6″. The number again rose to 15 at the depth of 9″. In grassy plot, the number of fungi, on Czapek's agar decreased gradually upto the depth of 9″ but it increased at the depth of 12″ to 16. This irregularity in Czapek's Dox agar may have been produced by the bacteria which hinder fungal growth. It also appears from these results that the type of crop on the surface of soil did not markedly influence the number of fungi.

The *Aspergilli* and *Penicilli* as reported by Chand[3] predominated all the rest of the fungal flora. The *Curvularia* species were also found in abundance.

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BOOK NOTICES

An Introduction to the Principles of Metalworking. Geoffrey W. Rowe. 297 pp. Edward Arnold Publishers Ltd., London, W.1. 1965. Price 35s.

The theoretical background of metalworking processes is presented in this book in a manner which can be understood and applied by metallurgists and engineers directly concerned with improving production in industry. It covers all the theory of plasticity necessary for this purpose, but requires no mathematics beyond university entrance level.

The book is suitable for use as a textbook in metalworking plasticity for several existing courses in applied metallurgy and mechanical engineering at university degree level. The first part of the book covers the appropriate parts of the syllabuses for Institution of Metallurgists examinations and should be suitable for use in technical colleges.

The numerical examples, which are an integral part of the book, have been fully worked out so that the book can also serve as a basis for home study.

Reinforced and Prestressed Concrete in Torsion. Henry J. Cowan and Igor M. Lyalin. 136 pp. Edward Arnold (Publishers) Ltd. London W. 1. 1965. Price 35s.

Torsion is generally a secondary effect in reinforced and prestressed concrete buildings. Con-