The excess water was drained off, the beans cooled and dried, but enough moisture was maintained to permit fungal growth. A spore suspension of six species of *Rhizopus* was prepared in 1.5 ml of sterilized water, which was used to inoculate the beans tightly packed in petriplates (7 cm size) in each case. The incubation period was 20 hr at 31 C. Subsequently fermentation takes place and *tempeh* is obtained as a compact mass. It can be removed from the petriplate as a solid cake. Good quality *tempeh* has a fresh, pleasant slightly mushroomy odour. It should not be musty or sour because it is then considered unpalatable (figure 1).

The best results were obtained with *Rhizopus oligosporus*. It not only imparted a good flavour and colour to the *tempeh*, but also formed a compact mass which was covered with a white mouldy growth. This was followed by *R. stolonifer*, *R. oryzae*, *R. microsporus*, *R. arrhizus* and *R. chinensis*. In the case of *R. arrhizus* and *R. chinensis* the mycelial penetration of the beans was minimal, specially with *R. chinensis*; the beans were loosely bound. Except for *R. chinensis*, which was utilized for the first time in *tempeh* production, the findings were similar to those of Hesseltine *et al*[7]. All the three yellow-seeded cultivars of soybean produced satisfactory *tempeh* but the black-seeded (Jawa-16) did not yield *tempeh*.

One of the major constraints with the popularisation of *tempeh* as a food is its short shelf-life. This is because, if the mould growth is allowed to continue, the product acquires an ammoniacal smell. This can be controlled by boiling slices of *tempeh* in 10% brine[7]. These slices are then dried, wrapped in polythene and stored in the deep-freeze. It was observed that no deterioration in taste or smell occurred upto 10 days and this method can be utilized by industrialists as well.

The results reported in this note are based on the M.Sc thesis of RS.

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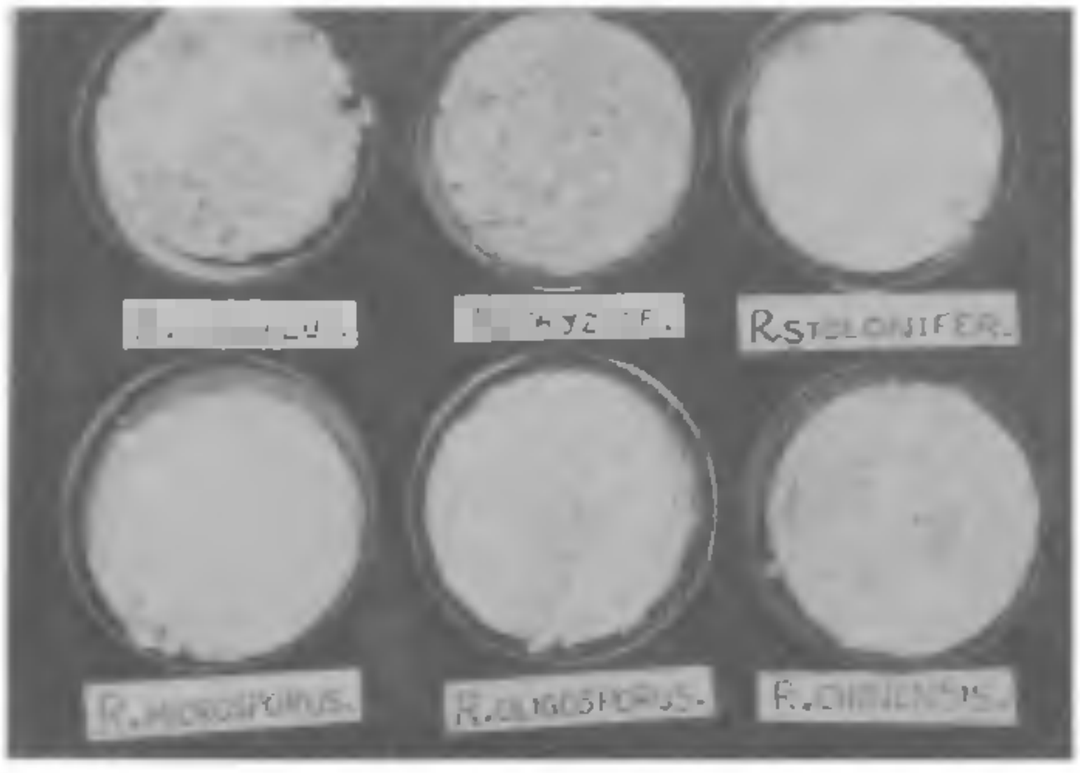

Figure 1. Tempeh cakes fermented by different *Rhizopus* species.

1. Stahel, G., *J. N. Y. Bot. Garden*, 1946, **36**, 285.
2. van Veen, A. G. and Schafer, G., *Doc. Neerl. Indones. Morbis Trop.*, 1950, **2**, 270.
3. Boedijn, K. B., *Sydowia Ann. Mycol.*, 1958, **12**, 361.
4. Steinkrans, K. M., Powee Hwa, Yap, van Barm, J. P., Providents, M. J. and Hand, B. B., *Food Res.*, 1960, **25**, 777.
5. Hesseltine, C. W., *Mycologia*, 1965, **57**, 149.
6. Djien, K. S. and Hesseltine, C. W., *Soybean Q. S.*, 1961, **22**, 14.
7. Hesseltine, C. W., South, M., Bradle, B. and Djien, K. S., *Dev. Ind. Microbiol.*, 1963, **4**, 275.

ON THE MORPHOLOGICAL DIFFERENCES BETWEEN *DACTYLOCTENIUM AEGYPTIUM* AND *DACTYLOCTENIUM ARISTATUM* (GRAMINEAE)

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DACTYLOCTENIUM AEGYPTIUM (L.) P. Beauv. is an important fodder grass of the rainy season. It is widespread in the tropical regions of the old world and has *D. aristatum* Link as a close relative, the distribution area of which is north-west Africa to north-west India.

In the current taxonomic literature, the morphological differences between *D. aegyptium* and *D. aristatum* are sought in the presence or absence of stolons, spike length, number of racemes per spike and the extent of prolongation of the rachis. According to Bor[1], *D. aegyptium* is stoloniferous with spikes 2-5 cm long and the tip of the rachis extends upto 2 mm in length. On the other hand, *D. aristatum* is not stoloniferous with spike 0.5–2 cm long and the tip of rachis is produced upto 4 mm. However, the separation of *D. aristatum* from *D. aegyptium*, on the basis of above characters, has been found to be extremely difficult in the N.W. Indian populations of these species.

The morphological differences between *D. aegy-*

ptium and *D. aristatum* mentioned in the literature have been presently examined by observations on living and herbarium specimens. A total of 105 populations of these species were studied for the spike length and the prolongation of the rachis. It is seen that the spike length varies from 2–4.5 cm in *D. aegyptium* and from 1 to 4.5 cm in *D. aristatum* without any discontinuity. This character, therefore, cannot be used in separating *D. aristatum* from *D. aegyptium*. The prolongation of rachis, on the other hand, was observed to be 1–2.5 mm in *D.aegyptium* and 2.5–5 mm in *D. aristatum*. A number of other morphological characters such as the growth habit, plant length, internode length, number of racemes per spike, sheath length, lamina length, lamina breadth, lamina hairiness and characters of glumes and lemma were then studied in order to assess their taxonomic utility. Of all these characters, the character of lamina hairiness was helpful in separating populations of *D. aristatum* from those of *D. aegyptium*. As a result of these studies, Bor's key for the separation of *D. aristatum* from *D. aegyptium* is modified as under:

1. Plants stoloniferous; erect, prostrate to decumbent; tip of the rachis shortly produced, upto 2.5 mm long; leaf lamina sparsely hairy . . . . *D. aegyptium.*

2. Plants not stoloniferous; erect to prostrate; tip of rachis upto 5 mm long (always more than 2.5 mm); leaf lamina profusely hairy . . . *D. aristatum.*

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1. Bor, N. L., *Grasses of Burma, Ceylon, India and Pakistan.* Pergamon Press, Oxford, 1960.

PRODUCTION OF CELLULOLYTIC ENZYME BY *RHIZOCTONIA SOLANI* KÜHN

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RHIZOCTONIA SOLANI Kühn the casual organism of sheath blight disease of rice, is a soil-borne facultative saprophyte, known for its secretion of heat-stable metabolites as well as the cell wall degrading enzymes[1]. The disease incited by *R. solani* is one of the major diseases of rice in tropical Asia. The aim of the present investigation is to know about the quantitative changes in the production of cellulolytic enzymes by differentially agressive isolates of *R. solani.*

Fungal mat from 6-day old cultures of less agressive (R_1) and agressive (R_5) isolates of *R. solani* grown on potato dextrose agar (PDA), washed thoroughly with sterile-distilled water, was used as inoculum. Czapek's broth, which supported the maximum growth of the fungus was used by substituting carboxy methyl cellulose (CMC, 0.25%) for sucrose. The cell-free samples were colleced on alternate days after centrifugation at 3,000 rpm. The enzyme cellulase activity was determined by the viscosimetric method[2] and the reaction components were temperature equilibrated and mixed in the following proportions: 2 ml of the culture filtrate, 8 ml of 1% CMC in 0.05 M acetate buffer at pH 4.5. Viscosity of the reaction mixture was determined by a viscosimeter at 30°C after an incubation period of 10 min. Boiled culture filtrate served as control. The activity was converted to viscosimetric units by calculating the reciprocal of the time required for 1 ml of the enzyme solution to reduce the viscosity of the substrate by 50%. The enzymatic activity was also determined colorimetrically by estimating the reducing sugars[3]. The reactive mixture was the same as that used for the viscometric method. The developed

Table 1 *Cellulase production by the less aggressive (R_1) and aggressive (R_5) isolates of R. solani*

Days of incubation	Enzyme activity (units)		Reducing sugars (μg of glucose)		Growth (mg dry wt)	
	(R_1)	(R_5)	(R_1)	(R_5)	(R_1)	(R_5)
2	40	80	50	55	4	5
4	85	180	120	250	7	8
6	55	120	80	115	10	12
8	50	110	50	95	16	18
10	45	100	40	55	22	25