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Some New Storage and Market Diseases in Saudi Arabia. II. Fruit Diseases

M.Y. Kassim, H.M. Sheir* and Shamsher Khan

Botany Department, College of Science, King Saud University, Riyadh, Saudi Arabia.

Studies were carried out on apple, sweet orange, guava, papaw, pear and zizyphus fruits. The isolated fungi which were pathogenic to their respective hosts were *Alternaria alternata* from apple fruits; *A. alternata, Aspergillus niger, Geotrichum candidum* and *Penicillium digitatum* from orange fruits; *A. alternata, Aspergillus fumigatus* and *Phomopsis psidii* from guava fruits; *A. niger* from papaw fruits; *Mucor racemosus* from pear fruits and *Drechslera spicifera* from zizyphus fruits.

Optimum temperature for growth was 15 °C for *Geotrichum candidum*; 20 °C for *A. alternata* (guava and citrus fruits isolates), and *Penicillium digitatum*, 25 °C for *Phomopsis psidii, A. alternata* (apple isolate) and *Drechslera spicifera* and 30 °C for *Aspergillus fumigatus, Aspergillus niger* and *Mucor recemosus.*

Initial optimum pH value for growth was 6 for *A. alternata* (apple isolate), *Drechslera spicifera* and *Geotrichum candidum*; 7 for *A. alternata* (orange and guava isolates), *Aspergillus fumigatus, A. niger* (zizyphus and papaw isolates) and *Penicillium digitatum* and 8 for *Mucor recemosus.*

Sweet orange (*Citrus sinensis* Osbeck), guava (*Psidium guajava* L.), apple (*Pyrus malus* L.), pear (*Pyrus communis* L.), zizyphus (*Zizyphus jujuba* Lank) and papaw (*Carica papaya* L.) fruits are among the important fruits in the Kingdom. The fruits are liable to be attacked by certain fungi causing serious diseases during storage and marketing, resulting in heavy losses.

* *Present address: Plant Pathology Dept., Faculty of Agriculture, University of Alexandria, Egypt.*

Sweet orange fruits are subjected to infection by *Penicillium italicum* Wehmer, *Penicillium digitatum* Sacc. (Eckert and Kolbezan 1964; Kaul and Lall 1975), *Geotrichum candidum* LK. ex Pers. (Butler *et al.* 1965; Shankhapal and Hatwalne 1974; Kaul and Lall 1975), *Aspergillus niger* V. Tiegh, *Fusarium* species (Kaul and Lall 1975), *Curvularia lunata* (Wakkar) Boedijn (Singh and Tandon 1970) and *Rhizoctonia* sp (Ali 1970).

A severe fruit rot of guava caused by *Macrophoma allahabadensis* Kapoor and Tandon has been reported by Kapoor and Tandon (1970).

Apple fruit rot in the storage were reported to be caused by *Gliocephalotrichum bulbilium* Ellis and Hasseltine (Jamal-Uddin *et al.* 1972), *Penicillium expansum* Thom. (Eckert and Kolbezen, 1964), and *Trichothecium roseum* Link ex. Fr. (Sree-Kantiah *et al.* 1974).

Eckert and Kolbezen (1964) attributed postharvest decay of pear fruits to *Penicillium expansum.*

Cladosporium oxysporum Berk and Curt was found to be a very common causal organism causing fruit rot of *Zizyphus jujuba* in the markets (Panwar and Vyas 1974). Vyas and Panwar (1976) observed three new rots of zizyphus fruits in the markets caused by *Botryodiplodia theobromae* pat, *Phoma destructive* and *Alternaria solani* (Ellis and Mart) Jones and Grout.

Fruit rot of papaw caused by *Ascochyta caricae* Pat had been reported by Chowdhary (1950) and by *Rhizopus stolonifer* (Ehrenb ex. Fr.) by Tandon and Mishra (1969).

Materials and Methods

Sweet orange, guava, apple, pear, zizyphus and papaw fruits were used throughout this work. Diseased materials were obtained from the cold stores and El-Riyadh markets.

Methods used for isolation, pathogenicity tests, temperature and H-ion studies are those given in a previous paper (Kassim, Sheir and Khan 1980).

Results

Isolation and identifications

The isolated fungi were identified by the authors according to Barnett and Hunter (1972), Ellis (1971), Kenneth and Dorothy (1965) and Kenneth *et al.* (1968). Verification of some of these fungi was carried out by the Commonwealth Mycological Institute. The isolated fungi were, *Geotrichum candidum* var. *citri aurantii* (Ferrar)

R. cif & F. Ciferri; *Alternaria-alternata* (Fr.) Keissler; *Aspergillus niger* V. Tiegh and *Penicillium digitatum* sacc from sweet orange fruits; *Phomopsis psidii* Nag Raj and Ponnappa apud ponnappa and Nag Raj; *Aspergillus-fumigatus* Fresenius and *Alternaria alternata* from guava fruits; *Acremonium hyalinulum* (Sacc) W. Gamms and *Alternaria alternata* from apple fruits; *Mucor racemosus* Fres from pear fruits; *Drechslera spicifera* (Bainier) Von Arx. from zizyphus fruits and *Aspergillus niger* from papaw fruits.

Pathogenicity experiments

Laboratory experiments were carried out to study the pathogenicity of the isolated fungi on their respective host.

Artificial inoculation of sweet orange fruits with the obtained fungi showed different rot symptoms. *A. alternata* infection resulted in dark black masses of spores and mycelium.

Depressed pits about 1–3 cm in diameter were made on the sweet orange and papaw fruits when inoculated with *Aspergillus niger*. The pits were first light coloured and soft but later turned dark and covered with mass of black spores.

Penicillium digitatum resulted in the characteristic green mould rot in orange. The symptom caused by *Geotrichum candidum* on orange fruits were light greyish coloured water soaked raised spots which gradually enlarged and involved the whole fruit. The whole fruit was ultimately decayed within 7–10 days.

Guava fruits infected with *Phomopsis psidii* developed discoloured areas on the surface in the beginning which gradually became dark brown at maturity. The tissue ultimately became a soft juicy mass. Dark smoky green spots were formed by *Aspergillus fumigatus* on the guava fruits which later became dark and more or less velvety. *A. alternata* caused dark black lesions on the surface of guava and apple fruits.

Pathogenicity was not successful when apple fruits were inoculated with its isolate, *Acremonium-hyalinulum.*

Drechslera spicifera developed localized dark brown spots on the surface of zizyphus fruits.

Mucor racemosus produced reddish brown spots on the pear fruits in the early stages but later became enlarged and dark coloured. The whole fruit ultimately became involved which was then covered by mycelium and spores of the fungus.

Effect of temperature on the fungal growth

The effect of temperature on the dry weights of isolated fungi are shown in Figs. 1–6. From the data obtained it appears that the optimum temperature for growth

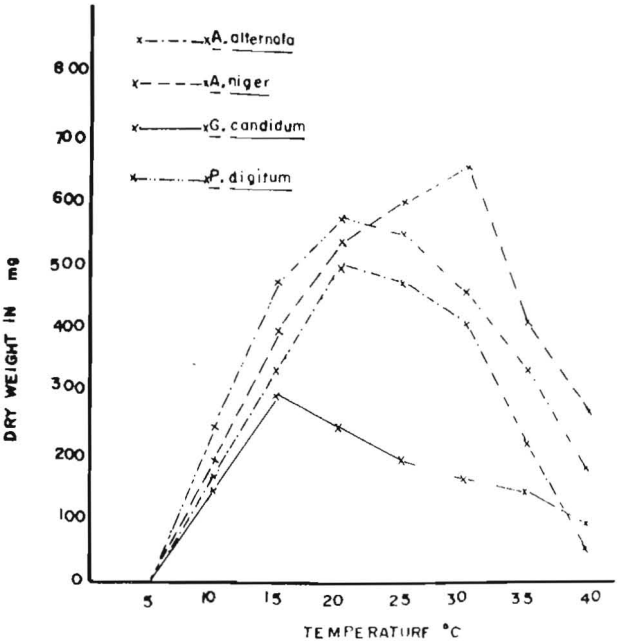

Fig. 1. Effect of temperature on the dry weight of the isolated fungi of citrus fruit.

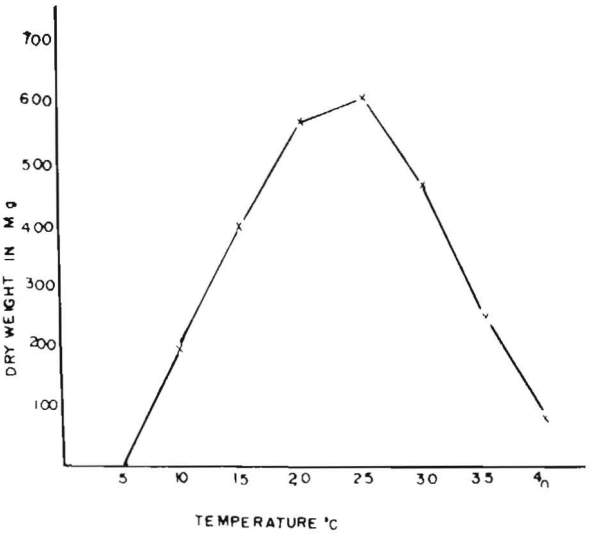

Fig. 2. Effect of temperature on the dry weight of *A. alternata* isolated from apple fruit.

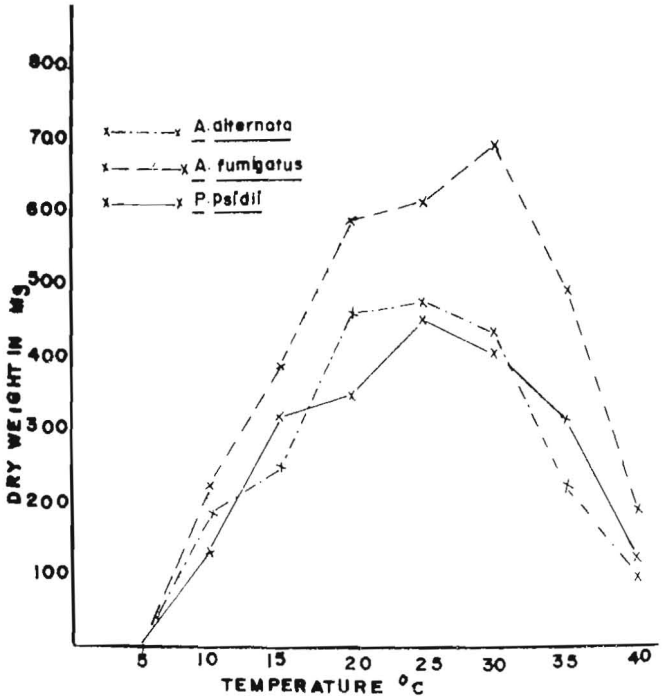

Fig. 3. Effect of temperature on the dry weight of the isolated fungi of guava fruit.

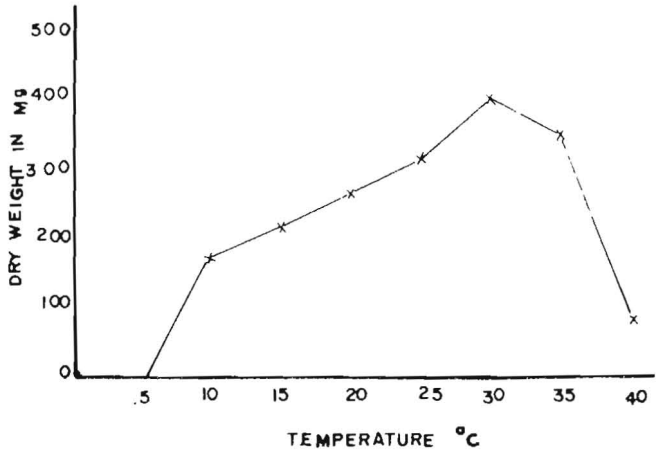

Fig. 4. Effect of temperature on the dry weight of *M. racemosus* isolated from pear fruit.

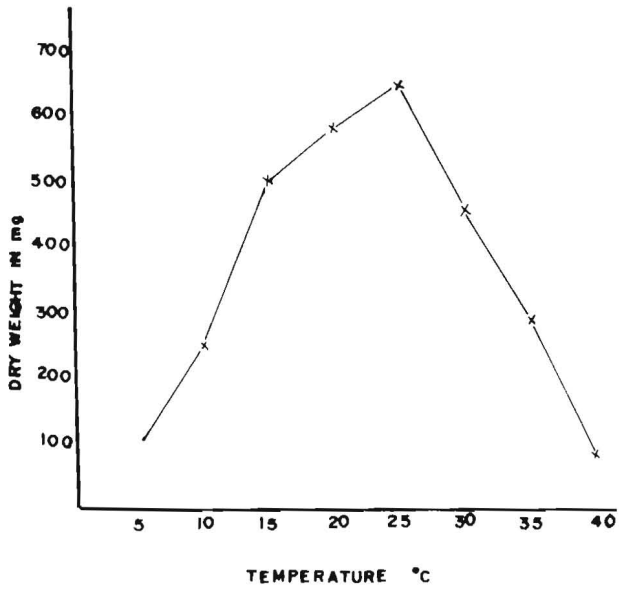

Fig. 5. Effect of temperature on the dry weight of *D. spicifera* isolated from zizyphus fruit.

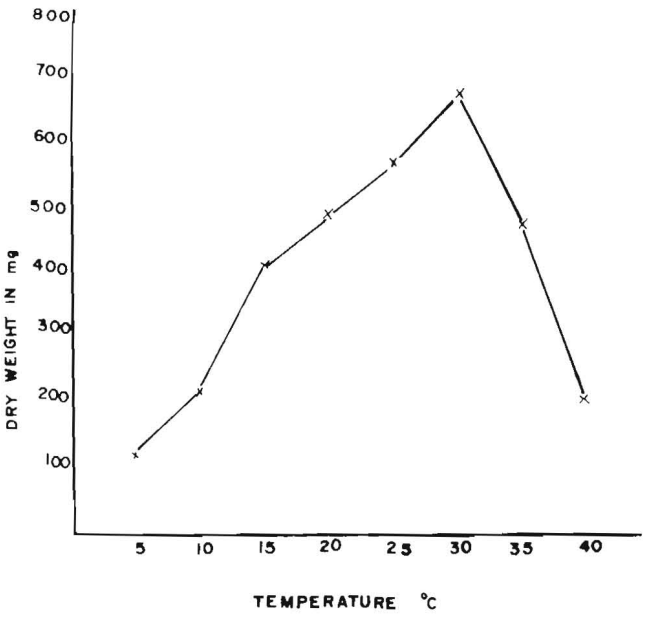

Fig. 6. Effect of temperature on the dry weight of *A. niger* isolated from papaw fruit.

was 15 °C for *Geotrichum candidum*; 20 °C for *A. alternata* (guava and sweet orange isolates) and *Penicillium digitatum*; 25 °C for *Phomopsis psidii*, *A. alternata* (apple isolate) and *D.* spicifera and 30 °C for *Aspergillus fumigatus*, *A. niger* and *M. racemosus.*

Effect of H-ion concentration on fungal growth

Data obtained from these experiments showed that the initial optimum pH value for growth was 6 for *Geotrichum candidum*, *A. alternata* (apple isolate) and *D. spicifera*; 7 for *P. psidii*, *A. fumigatus*, *A. alternata* (guava and orange isolates), *A. niger* (orange and papaw isolates) and *P. digitatum* and 8 for *Mucor racemosus.*

Discussion

Fruits in stores and markets are liable to be attacked by certain fungi causing serious diseases. The influence of the environment, particularly temperature and humidity plays a very important part in determining the nature and activity of the microflora. These factors can affect fungal advancement in the host indirectly by increasing or decreasing the resistance of the host.

Prasad and Bilgrami (1973) has suggested that the tissues of the fruits may become weak and susceptible during storage even at low temperature, but the infection was delayed because the pathogen was not able to grow at that temperature. Their results showed that storage of fruits at lower temperatures may prevent rapid losses, but a change from very low temperature (10 °C) to the room temperature resulted in severe infections within a few days.

Failure in getting apple fruit rot by artificial inoculation with its isolate, *Acremonium hyalinulum* might be due to the absence of favourable environmental conditions in the field during the pre-harvest stage or probably it is not pathogenic.

The explanation for the differences in the optimum temperatures for the growth of isolated fungi and that of cold stores and markets is probably the same as discussed in a previous paper (Kassim, Sheir and Khan 1980).

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بعض أمراض التخزين والتسويق الجديدة بالمملكة العربية السعودية . ٢ ـ امراض الفاكهة

حلمي محمد شعير ، محمد يحيى قاسم* وشمشيرخان
قسم النبات ، كلية العلوم ، جامعة الملك سعود ، الرياض ، المملكة العربية السعودية

جمعت لهذا البحث عينات مصابة من ثمار التفاح والبرتقال والجوافة والباباظ والكمثرى والنبق (السدر) من ثلاجات حفظ الفاكهة وأسواقها بالرياض وقد تم عزل بعض الفطريات المسببة لأعفان الثمار كالآتي :
ثمار التفاح *Alternaria alternata* ثمار البرتقال *A. alternata, Aspergillus niger.* ثمار الجوافة *Geotrichum candidum, Penicillium digitatum* ثمار الكمثرى *Mucor A. niger,* ثمار الباباظ *A. fumigatus, Phomopsis psidii, racemosus* وثمار النبق *Drechslera spicifera*
أجريت الدراسة على هذه الفطريات لمعرفة قدرتها على احداث الاصابة لعوائلها .
درس أيضا تأثير درجة الحرارة على نمو الفطريات الممرضة والتي تم عزلها ولقد وجد ان امثل درجة حرارة للنمو كانت ١٥°م للفطر *G. candidum* ، ٢٠°م للفطريات *A. alternata* (عزلتي الجوافة والبرتقال) ، *P. digitatum* ، ٢٥°م للفطريات *P. psidii* ، عزلة التفاح للفطر *A. alternata* والفطر *D. spicifera* ٣٠°م لباقى الفطريات .
تم كذلك دراسة تأثير تركيز ايون الايدروجين على نمو هذه الفطريات ولقد وجد ان امثل تركيز ايون ايدروجين لنمو الفطريات هو ٦ للفطريات *A. alternata* عزلة التفاح ، *D. spicifera* ، *G. candidum* ، ٧ للفطريات *A. alternata* (عزلتي البرتقال والجوافة) ، *A. fumigatus* ، *A. niger* (عزلتي النبق والباباظ) ، *P. digitatum* ، ٨ للفطر *M. racemosus* .

* العنوان الحالي : قسم امراض النبات ، كلية الزراعة ، جامعة الاسكندرية ، مصر