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Occurrence of Yeasts in Cultivated Soils in El-Minia City, Egypt

Mamdouh S. A. Haridy*

Botany Department, Faculty of Scince, El-Minia University, El-Minia, Egypt
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Two-hundred two yeast strains were isolated from rhizosphere (87 strains) and nonrhizosphere (115 strains) areas of potato, maize, vegetable marrow, and cabbage plants. On the basis of 26 morphological and physiological properties, the isolated yeast strains were assigned to 9 genera and 15 species. *Trichosporon beigelii*, *Kluyveromyces marxianus* and *Torulaspora delbrueckii* were the dominant species. *Cryptococcus humicolus* and Candida tropicalis were represented by considerable numbers of strains. Of low occurrence were *Saccharomyces cerevisiae* and *Candida blankii*. Other yeast species were represented by single or two strains. Total counts of yeast cells per gram dry soil ranged from 1.1×10^3 to 6.6×10^3 in soil samples of rhizosphere areas and from 6.5×10^2 to 5.6×10^3 in soil samples of nonrhizosphere areas. Types of the tested plants affected not only the total counts of yeast cells but also spectra of yeast species. Relationships of age of potato plant, moisture contents of soil samples, and its pH values and total counts of yeast cells were discussed.

KEYWORDS: Rhizosphere, *Trichosporon beiglii*, Yeasts

Yeasts are widely distributed in the nature. They have been found in soil of widely different texture, chemical composition, humidity, and pH value at various geographic locations and diverse climatic condition, in bare soils as well as in soil that support a natural vegetation or are cultivated by man (Do Carmo-Sousa, 1969). In most cases, especially agricultural soils, the soil should be regarded more as a reservoir for yeasts from sources above it than as a specific habitat. Although in some instances, there are many yeast species that are typical soil inhabitants and for which no obvious surface sources are known (Phaff *et al.*, 1978).

Except of the works done by Bab'Eva and Meaved (1967), Moawad (1971) and Monib *et al.* (1982a, b) on Egyptian soil, there is no recent studies to throw more light on yeast flora of Egyptian soils. Therefore, we planed to study occurrence of yeasts in cultivated soils in El-Minia city.

Materials and Methods

Soil particles that attached to root hairs were considered as rhizosphere soils while adjacent soil particles at depth ranging from 5 to 15 cm from soil surface and which were free from root hairs were considered as nonrhizosphere soils. 130 soil samples were collected from rhizospere (65 samples) and nonrhizosphere (65 samples) areas of soils cultivated with potato (40 samples), maize (40 samples), vegetable marrow (30 samples) and cabbage plants (20 samples) in sterile conical flasks and transferred directly to laboratory. Soil samples (5~10 g) were mixed with 50 m*l* sterile distilled water, vigorously shaken and series of dilution were made for inoculating petri dishes containing YM agar medium (Wickerham, 1951). In order to retard mould growth, 0.2% sodium propionate was added to the isolation medium. Inoculated plates were incubated at 25°C for 3~5 days. Yeast colonies were counted, picked, purified and maintained on YM-agar slants. Percentage of moisture contents of soil samples was determined by drying of 5~10 g soil samples in oven at 105°C for 24~48 hours. In order to estimate pH values of soil samples, 5~10 g soil samples were mixed by 50 m*l* distilled water, gently shaken, filtered and pH of filtrate was determined using digital pH meter (Orion Research model 201). For determining effects of root age on yeast flora of the rhizosphere area, potato plant was chosen for this purpose. Four soil samples from rhizosphere and nonrhizosphere areas of potato plant were collected every 15 days. Collection of soil samples was started when potato plant was 20 days old and continued for 3 months. Identification of yeast strains was performed using the procedures described by Barnett *et al.* (1983, 1990).

Results and Discussion

Total counts of yeast cells varied obviously in rhizosphere and nonrhizosphere areas of the tested plants. Results in Table 1 showed that the highest yeast cell counts were recorded in the collected soil samples from rhizosphere and nonrhizosphere areas of potato plant followed by vegetable marrow and maize plants. While the lowest yeast cell counts were detected in the collected soil samples of cabbage plant. It was also clear from Table 1 that the yeast cell counts of soil samples collected from

*Corresponding author

Table 1. Total counts of yeast cells as well as distribution of yeast species isolated from rhizosphere and nonrhizosphere areas of the tested plants

	Total numbers of strains (202)	Tested Plants							
		Potato		Vegetable marrow		Maize		Cabbage	
		R.[a]	NR.	R.	NR.	R.	NR.	R.	NR.
Total counts of yeast cells per gram dry soil	-	6.6×10^3	5.6×10^3	5.0×10^3	2.8×10^3	4.9×10^3	1.9×10^3	1.1×10^3	6.3×10^3
Percentage of yeast occurrence	-	85.7	82	67	60	75	65	70	60
Yeast species									
Tr.[b] *beigelii*	44	16(3)[c]	20(11)		3		2(1)		3(2)
K. marxianus	40	7(2)	8(2)			15(13)	4(4)		6(4)
T. delbrueckii	40		10(3)	8(4)	15(7)			7(6)	
Cr. humicolus	30	5(3)	9			9(2)	7(7)		
C. tropicalis	20		3(1)	10(6)	7(2)				
S. cerevisiae	8		3		5				
C. blankii	6		4			2			
C. intermedia	2						2		
C. melibiosica	2							2	
Cr. laurentii	2		2						
H. polymorpha	2	2							
P. guillermondii	2	1					1(1)		
Rh. aurantiaca	2							2(1)	
C. apicola	1	1							
Rh. mucilaginosa	1		1						

[a]R. = rhizosphere area, and Nr = nonrhizosphere area.
[b]*Tr.* = *Trichosporon*, *K.* = *Kluyveromyces*, *T.* = *Torulaspora*, *Cr.* = *Cryptococcus*, *C.* = *Can- dida*, *S.* = *Saccharomyces*, *H.* = *Hansenula*, *P.* = *Pichia*, and *Rh.* = *Rhodotorula*.
[c]Numbers of frequencies in which yeast species was represented by highest counts of yeast cells.

rhizosphere areas of the tested plants were generally higher than the counts recorded in nonrhizosphere areas. The yeast cell counts ranged from 1.1×10^3 to 6.6×10^3 and from 6.3×10^2 to 5.5×10^3 per gram dry soils of rhizosphere and nonrhizosphere areas respectively. Bab'Eva and Savel'Eva (1963) found that number of yeasts was alway greater in the rhizosphere than the corresponding soil. Lund (1954) and Phaff and Starmer (1987) found that total count of yeast cells ranged from few cells to 10^5 to 10^6 per gram soil. Miller and Webb (1954), Alexander (1961) and Faparusi (1978) regarded yeast as an unimportant component of soil microflora because the number of yeasts in soils is very small in relation to other members of microflora. Phaff and Starmer (1987) suggested that yeasts occur in very small numbers compared to bacteria, actinomycetes, and moulds and do not seem to play a major quantitative role in the decomposition of organic matter in soil.

Results in Table 1 also showed that the percentage of yeast occurrence ranged from 67% to 85.7% in the rhizosphere and from 60 to 82% in the nonrhizosphere areas. Monib *et al.* (1982b) found that the percentage of yeast occurrence was 47.8% in rhizosphere soils and 28.6% in root free soils in Egyptian soils cultivated with sugarcane, lupin, barley, wheat, castor oil plants, and clover. Di Menna (1960) concluded from qualitative and quantitative surverys of the yeast flora of New Zealand soils that yeast populations varied qualitatively from place to place with soil type and vegetation but not with season, while the density of yeast populations was different from place to place and also varied with season. Bab'Eva and Belyanin (1966) found that the multiplication of yeasts within the rhizosphere was depend not only on host species but also on seasonal growth factors.

Results in Table 1 showed that spectra of yeast species, especially the dominant species, were varied depending on types of cultivated plants. Six and nine yeast species were detected in soil samples collected from rhizosphere and nonrhizosphere areas of potato plant, respectively. *Trichosporon beigelli* was the dominant species in both areas. *Kluyveromyces marxianus* and *Cryptococcus humicolus* were represented by considerable numbers of strains and also found in both areas. Characteristic for nonrhizosphere area was the isolation of *Torulaspora delbrueckii* in moderate numbers. *Candida blankii*, *Candida tropicalis* and *Saccharomyces cerevisiae* were only isolated from nonrhizosphere area and represented by 3 or 4 strains. Other yeast species were represented by single or two strains. In case of vegetable marrow, *T. delbrueckii* and *C. tropicalis* were isolated from rhizosphere and nonrhizosphere areas. *C. tropicalis* was dominant in rhizosphere area followed by *T. delbrueckii*, while the reverse

was detected in nonrhizosphere area (Table 1). Moreover, *S. cerevisiae* and *T. beigelii* were only isolated from nonrhizosphere area. Concerning the yeast spectra of rhizosphere and nonrhizosphere areas of maize plant, *K. marxianus* and *C. humicolus* were isolated from soil samples of both areas. *K. marxianus* was prevailed in rhizosphere area followed by *C. humicolus*, while the reverse was recorded in nonrhizosphere area. Other yeast species were represented by few numbers of strains. In case of cabbage plant, *T. delbrueckii* was the most dominant species in rhizosphere area, while *K. marxianus* was prevailed in nonrhizosphere area. Other yeast species were of low occurrence.

Generally, the results in Table 1 showed that *T. beigelii*, *K. marxianus* and *T. delbrueckii* were the most dominant species followed by *C. humicolus* and *C. tropicalis*. *S. cerevisiae* and *C. blankii* were represented by considerable numbers of strains. *C. blankii*, *C. tropicalis* and *T. beigelii* were isolated by Monib *et al.* (1982) from Egyptian soils. *C. humicolus* was considered as a typical soil inhabitant yeast species by Phaff and Starmer (1987).

Results of investigation of relationships of plant age, pH values of the soil samples, and its moisture contents and total counts of yeast cells showed that total yease cell counts were gradually increased as potato plant was growing up (Table 2). It was clear from Table 2 that the highest counts of yeast cells were detected in rhizosphere area when potato plants were 50 days old. The moisture contents of the soil samples were 30% and pH values of soil samples were 8.20. In nonrhizosphere areas the highest yeast cell counts were recorded after 65 days from potato plant cultivation when moisture contents of soil samples were 25% and pH value of soil samples were 8.45 (Table 2).

Table 2. Relationships of potato plant age, moisture contents of soil samples, pH values of soil sample and the total counts of yeast cells in rhizosphere and nonrhizosphere areas

Age of potato plant (days)	Moisture contents of soil samples		pH values		Total count of yeast cells/g dry soil	
	R.[a]	Nr.	R.	Nr.	R.	Nr.
20	28[b]	30	8.85	8.85	3.12×10^3	1.89×10^3
35	28	30	8.55	8.55	5.22×10^3	3.65×10^3
50	30	31	8.20	8.25	1.66×10^4	5.11×10^3
65	18	25	8.35	8.45	4.81×10^3	1.53×10^4
80	17	19	8.35	8.55	3.25×10^3	1.95×10^3

[a]R. = rhizosphere, Nr. = non-rhizosphere.
[b]Average number of yeast cells per gram dry soils of 4 samples as well as average of moisture contents and pH values of the 4 soil samples.

Physiological and morphological properties of the isolated yeast strains were recorded in Table 3. It was clear from Table 3 that 40% of the isolated yeast strains were only strict aerobic while 60% of strains had fementative ability. This situation was different from that recorded by Phaff and Starmer (1987) who found that great majority of yeasts isolated from soils lack fermentative ability, and

Table 3. Physiological and morphological properties of the isolated yeast strains

Yeast species	Total number of strains tested (201)	Fermentation					Assimilation															Growth at		Building of			
		glucose	galactose	maltose	sucrose	lactose	glactose	sorbose	ribose	xylose	arabinose	rhamnose	sucrose	maltose	lactose	raffinose	ribitol	mannitol	gluconate	succinate	citrate	37°C	42°C	ascospores	true mycelium	pseudo-mycelium	pellicle
Tr. beigelii[a]	43	0[b]	0	0	0	0	100	100	100	100	77	85	93	93	100	100	93	93	93	93	77	93	9	0	100	100	100
K. marxianus	40	100	20	20	10	0	100	91	30	100	10	0	100	91	20	80	60	91	41	100	41	100	41	100	0	100	100
T. delbrueckii	40	100	0	0	0	0	75	0	0	100	0	0	100	50	0	0	0	0	0	100	0	50	0	100	0	50	50
Cr. humicolus	30	0	0	0	0	0	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	23	0	0	100	100	100
C. tropicalis	20	100	100	100	100	0	100	100	0	100	0	0	100	100	0	0	100	100	100	100	100	100	100	0	0	100	100
S. cerevisiae	8	100	0	0	0	0	50	0	0	50	0	0	100	50	0	50	0	0	0	0	0	100	100	100	0	100	100
C. blankii	6	100	50	50	50	0	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	0	100	100	100
C. intermedia	2	100	100	100	100	0	100	100	100	100	0	0	100	100	100	100	100	100	100	100	100	100	100	0	0	100	100
C. melibiosica	2	100	100	100	100	0	100	100	100	100	0	0	100	100	0	100	100	100	100	100	100	100	100	0	0	100	100
H. polymorpha	2	100	0	0	0	0	100	0	0	100	0	0	100	100	0	0	0	0	0	0	0	100	100	100	0	0	0
Cr. laurentii	2	0	0	0	0	0	100	100	0	100	100	100	100	100	100	100	100	100	0	100	100	100	0	0	0	100	100
Rh. aurantiaca	2	0	0	0	0	0	0	0	0	0	0	0	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C. apicola	1	0	0	0	0	0	0	0	0	0	0	0	100	0	0	0	0	0	0	100	0	0	0	0	0	0	0
P. guillermondii	2	100	0	0	0	0	100	100	100	100	100	100	100	100	0	100	100	100	100	100	100	100	0	100	0	100	100
Rh. mucilaginosa	1	0	0	0	0	0	100	100	100	100	100	100	100	100	100	100	100	100	100	100	0	0	0	0	0	0	0

[a]*Tr.* = *Trichosporon*, *K.* = *Kluyveromyces*, *T.* = *Torulaspora*, *Cr.* = *Cryptococcus*, *C.* = *Candida*, *S.* = *Saccharomyces*, *H.* = *Hansenula*, *P.* = *Pichia*, and *Rh.* = *Rhodotorula*.
[b]Percentage of positive reactions of isolates.

thus depend on aerobic metabolism for their growth.

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