

Occurrence and Population Densities of Yeast Species in the Digestive Tracts of Gulls and Terns

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SUMMARY

From the intestinal tracts of 37 out of 69 birds belonging to four species of gulls (*Larus fuscus*, *L. genei*, *L. argentatus*, *L. ridibundus*) and three species of terns (*Sterna sandvicensis*, *S. hirundo*, *S. minuta*) 62 yeast isolates belonging to 16 species were obtained. The occurrences of individual yeast species were (% of positive birds in brackets): *Saccharomyces cerevisiae* (20%), *Torulopsis glabrata* (12%), *S. oleaginosus* (10%), *Candida tropicalis* (9%), *C. albicans* (9%) and *T. pintolopesii* (7%), other yeast species (1-4%). Average numbers of colony-forming units/g. wet intestinal contents in the seven host species were: *Larus fuscus* 5210; *Larus genei* 22,200; *L. argentatus* 5620; *L. ridibundus* 3180; *Sterna sandvicensis* 50; *S. hirunda* 211,000; *S. minuta* 9200.

INTRODUCTION

In recent years attention has been given to the intestinal yeast flora of several mammal and bird species (van Uden, 1963), but little to marine birds. High numbers of viable yeasts were found in the digestive tract of *Larus occidentalis* (Western Gull) by van Uden & Castelo-Branco (1963). It was thought of interest to examine whether gulls and terns are, in general, suitable hosts for intestinal yeasts and to obtain information on the population densities and specific composition of their intestinal yeast flora. The possible role of marine birds in the dispersal of marine-occurring yeasts (Taysi & van Uden, 1964; van Uden, 1964) gave additional stimulus to seeking such information. To be reported here are qualitative and quantitative findings on intestinal yeasts in 69 birds belonging to 7 species of gull and tern.

METHODS

Isolation medium (% w/v): glucose, 2; peptone (Difco), 1; yeast extract (Difco), 0.5; agar, 2; distilled water. The medium was adjusted to pH 4.5 to discourage bacterial growth.

Isolation. Free-living gulls and terns were caught along the coast of Portugal and samples were taken from rectal contents. Weighed portions of the samples were suspended in sterile water and serial dilutions plated in 1 ml. volumes in isolation medium. After incubation at 37° for 48-72 hr, the numbers of yeast colonies were recorded according to macroscopic and microscopic morphology. Representatives of each type were subcultured for later identification.

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Identification of the yeast isolates. The methods described by Lodder & Kreger-van Rij (1952), Wickerham (1951), van Uden & Farinha (1958), and Buckley & van Uden (1963), were used.

RESULTS

Of 69 birds sampled, 37 harboured yeasts in detectable numbers. The total number of isolated strains was 62, which corresponds to a total-yeast index (van Uden, 1960) of 0.9. These figures indicate that gulls and terns are hosts of medium suitability for intestinal yeasts, similar to other omnivorous host species (e.g. humans, swine; van Uden, 1960, 1963).

Table 1. *Yeast species from the intestinal tracts of 69 gulls and terns*

Yeasts isolated	No. of birds positive	Percentage incidence of yeast species
<i>Saccharomyces cerevisiae</i>	14	20
<i>Torulopsis glabrata</i>	8	12
<i>Saccharomyces oleaginosus</i>	7	10
<i>Candida tropicalis</i>	6	9
<i>C. albicans</i>	6	9
<i>T. pintolopesii</i>	5	7
<i>C. krusei</i>	3	4
<i>C. norvegensis</i>	3	4
<i>C. tenuis</i>	3	4
<i>C. lusitaniae</i>	1	2
<i>C. parapsilosis</i>	1	2
<i>C. utilis</i>	1	2
<i>T. famata</i>	1	2
<i>Saccharomyces</i> sp.	1	2
<i>Prototheca</i> sp.	1	2

Table 2. *Yeast population densities in the digestive tracts of 7 gull and tern species*

No. of birds tested	Species of bird	No. of birds with yeasts	Average numbers of colony-forming units/g. wet intestinal contents	
			(a) Positive birds	(b) All tested birds
26	Lesser Black-Backed Gull (<i>Larus fuscus</i>)	12	11,280	5,210
4	Slender-Billed Gull (<i>L. genei</i>)	3	29,600	22,200
4	Herring Gull (<i>L. argentatus</i>)	1	22,500	5,600
11	Black-Headed Gull (<i>L. ridibundus</i>)	5	7,000	3,180
3	Sandwich Tern (<i>Sterna sandvicensis</i>)	2	70	50
6	Common Tern (<i>S. hirunda</i>)	5	253,100	211,000
15	Hooded Tern (<i>S. minuta</i>)	9	11,500	9,200
Total 69		37	44,600	23,900

The species of yeast isolated and their respective incidences are listed in Table 1. The six most frequently isolated species included *Torulopsis glabrata* and *Candida tropicalis*. These two species were also predominant in a group of Western Gulls

studied earlier (van Uden & Castelo-Branco, 1963). In the present survey *Saccharomyces cerevisiae* was the most frequent species. Van Uden & Carmo-Sousa (1962) found that this yeast was capable of multiplication in the digestive tract of swine and must be regarded as a facultative intestinal saprophyte. *T. glabrata* and

Table 3. Occurrence and population densities of yeast species in the digestive tracts of 7 gull and tern species

Host species	No. of birds tested	No. of birds with yeasts	Yeast species	No. of birds with species	Average population density of each yeast species in the digestive tracts of the birds harbouring this species (colony-forming units/g. wet intestinal contents)
Lesser Black-Backed Gull (<i>Larus fuscus</i>)	26	12	<i>Candida albicans</i>	5	26,716
			<i>Saccharomyces cerevisiae</i>	4	35
			<i>Torulopsis glabrata</i>	3	135
			<i>C. tropicalis</i>	2	49
			<i>C. krusei</i>	1	48
			<i>C. norvegensis</i>	1	1,110
			<i>T. pintolopesii</i>	1	25
			<i>S. oleaginosus</i>	1	13
Slender-Billed Gull (<i>L. genei</i>)	4	3	<i>C. norvegensis</i>	1	33,916
			<i>C. parapsilosis</i>	1	2,796
			<i>C. tropicalis</i>	1	1,004
			<i>T. pintolopesii</i>	1	11,000
			<i>T. glabrata</i>	1	24,667
			<i>S. oleaginosus</i>	1	15,417
Herring Gull (<i>L. argentatus</i>)	4	1	<i>T. glabrata</i>	1	2,800
			<i>T. pintolopesii</i>	1	200
			<i>C. krusei</i>	1	200
			<i>S. cerevisiae</i>	1	19,000
			<i>Saccharomyces</i> sp.	1	300
Black-Headed Gull (<i>L. ridibundus</i>)	11	5	<i>T. glabrata</i>	2	890
			<i>T. pintolopesii</i>	2	6,850
			<i>C. albicans</i>	1	1,770
			<i>C. lusitaniae</i>	1	620
			<i>C. tenuis</i>	1	22,500
			<i>S. cerevisiae</i>	1	2,060
Sandwich Tern (<i>Sterna sandvicensis</i>)	3	2	<i>C. tropicalis</i>	1	40
			<i>S. cerevisiae</i>	2	60
Common Tern (<i>S. hirundo</i>)	6	5	<i>T. glabrata</i>	1	134,880
			<i>C. tropicalis</i>	1	78,680
			<i>C. krusei</i>	1	880,000
			<i>C. norvegensis</i>	1	10
			<i>S. oleaginosus</i>	3	57,373
Hooded Tern (<i>S. minuta</i>)	15	9	<i>C. tropicalis</i>	1	240
			<i>C. utilis</i>	1	640
			<i>C. tenuis</i>	2	3,000
			<i>T. candida</i>	1	6,700
			<i>S. oleaginosus</i>	2	31,850
			<i>S. cerevisiae</i>	6	10,053
			<i>Prototheca</i> sp.	1	300

C. albicans are polyspecific obligatory intestinal saprophytes with potential pathogenicity; they occur in a wide range of hosts (van Uden, 1963). The occurrence of the oligospecific *T. pintolopesii* in gulls and terns is surprising since this yeast is known as an obligatory saprophyte of small rodents; however, it has also been obtained from pigeons (van Uden, 1960). *Saccharomyces oleaginosus* (*S. italicus* var. *melibiosi*) is probably a facultative intestinal saprophyte; it was isolated previously from humans and horses (van Uden & Assis-Lopes, 1957) and from swine (van Uden & Carmo-Sousa, 1962). Outside the animal body this yeast is frequent in the watery discharge from fermenting stacked olives (Santa Maria, 1963).

The average number of colony-forming units/g. wet intestinal contents was 44,600 for the 37 birds which harboured yeasts at all, and 23,900 for the total of 69 birds studied (Table 2). Among the seven host species the yeast population densities varied between 50 and 211,000 colony-forming units/g. wet intestinal contents. Whether this wide range of population densities is indicative of differences in host suitability for yeasts between the bird species cannot be ascertained from the relatively small numbers of specimens tested within each host species. Nevertheless, the yeast species distribution among the birds and their respective population densities (Table 3) suggest that host suitability for intestinal yeasts is a property of gulls and terns as a group rather than of certain species of these birds.

Gulls and terns must inoculate yeasts with their faeces into natural water bodies the world over. *Torulopsis glabrata*, *Candida tropicalis*, *C. krusei*, and other yeasts which occur in these birds, have been encountered in tropical and subtropical marine water bodies as predominant yeasts (Fell & van Uden, 1963; van Uden & Castelo-Branco, 1963; van Uden, 1964). In temperate and cold-water bodies such intestinal yeasts have so far not been detected, regardless of the presence of gulls and terns or other sources of intestinal yeasts (sewage). There is some evidence that intestinal yeasts are outgrown in temperate and cold-water bodies by yeasts which have lower cardinal temperatures (Taysi & van Uden, 1964).

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