

A new pattern of hermaphroditism (inducible hermaphroditism) in populations of *Ophryotrocha labronica* (Annelida Polychaeta)

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Summary. A new kind of hermaphroditism, which is called 'inducible hermaphroditism', has been discovered in the otherwise gonochoristic populations of *Ophryotrocha labronica* of the Gulf of Naples and of the Lagune of Venice. Inducible hermaphrodites, which are fertile in both the male and female phases, represent 25.8% and 31.8% of the Naples and Venice strains respectively. Inducible hermaphrodites are obtained when pairs between adult females – or female phase hermaphrodites – and juveniles are formed. Crosses between inducible hermaphrodites, in different sex phases, pure male and female individuals give progenies whose sex ratios are clearly correlated with the sex genotypes of the parents.

Populations of *Ophryotrocha labronica*¹ show varying degrees of reproductive isolation² and are either gonochoristic or hermaphroditic. The species was first described on a strain collected in Livorno (Livorno I) which proved to be balanced hermaphroditic as it was composed by proterandric hermaphrodites only; they were also capable of self-fertilisation^{1,3}. Strains collected in Faro (Portugal) and in Naples (Napoli III) are, on the other hand, unbalanced hermaphroditic because they are composed of both hermaphrodites and low percentages of pure male and female individuals^{2,4}.

Most populations of *O. labronica*, collected in several harbours in the Mediterranean, and also on the coast of California, are gonochoristic and show highly variable sex ratios, according to the extensive researches carried out by Åkesson².

A strain which was collected in Naples in 1975 (Napoli IV) and a strain obtained from the Lagune of Venice (Venezia strain) in 1976 are also gonochoristic. In fact, when individuals measuring from 6 to 7 chaetigerous segments are taken from mass cultures and raised in isolation in small Boveri dishes, they develop either as males or as females.

The Napoli IV strain shows 62.3% males out of a sample of 122 individuals and oocytes appear in the females at a mean length of 12.9 ± 0.17 chaetigerous segments; 52.1% males out of a sample of 169 individuals are present in the Venezia strain and oocytes appear in the females of this strain at the mean length of 13.72 ± 0.17 segments.

Consistently different results are obtained in both strains when adult individuals provided with developing oocytes and young individuals ranging from 5 to 6 segments in length are taken from mass cultures and united to form pairs. Such pairs are also confined in Boveri dishes containing about 14 cm³ of sea water and fed with spinach. The adults (about 13.5 segments in length) soon accelerated the growth of oocytes and laid eggs as a consequence of pair formation. The younger partners either fertilized the eggs laid by the adult partners or developed (within about 7 days) into females and were employed in other experiments. The young partners that did not differentiate into females were separated from the adults soon after

performing fertilization and kept isolated afterwards. In this condition, they either remained males or they developed oocytes within 12 days of isolation. The latter can properly be named inducible hermaphrodites because their transient male phase is evidently induced by some interaction – or pair culture effect⁵ – which takes place during their close vicinity or contact with oocytes-bearing adults that, on the basis of the present result, must be regarded either as females or as female phase hermaphrodites.

The individuals that are raised in isolation (initially unpaired – or IU – individuals) thus develop into 2 sex phenotypes only: males and females. The individuals that were temporarily kept in close association with oocytes-bearing individuals and were subsequently separated from their partners (temporarily paired – or TP – individuals), develop into 3 sex phenotypes, that is into males, proterandrous hermaphrodites and females. The proportions of the males, inducible hermaphrodites and females in the IU and in the TP individuals of both the Venezia and Napoli IV strains are shown in table 1.

The numbers of females plus inducible hermaphrodites obtained in the categories of the TP (or temporarily paired) individuals coincide quite satisfactorily in both strains with the numbers and proportions of females obtained by rearing the young *labronica* in isolation (the IU categories), as appears even more evident in the diagrams of the figure.

The inducible hermaphrodites of both populations thus correspond to portions of the female phenotypes obtained in the IU categories. Since it can be assumed that the male-determining factors are more strongly represented in the hermaphroditic than in the purely female phenotypes, it can also be inferred that the females of the IU category must be considered either as strong females or as weak females corresponding to the females (or standing females) or to the inducible hermaphrodites of TP categories respectively.

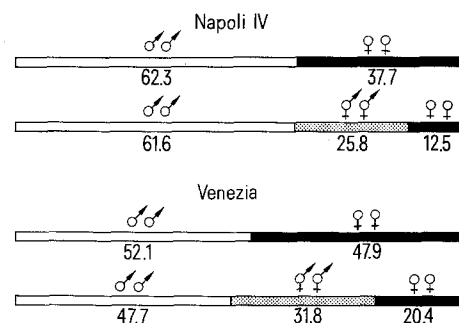
4 kind of crosses are possible between males, hermaphrodites and females in order to test the above interpretation, namely:

1. ♂♂ × ♀♀
2. ♂♂ × ♀♀
3. ♀♀ × ♂♂
4. ♀♀ × ♀♀

Table 1

Strains		Males	Inducible hermaphrodites	Females
Venezia	IU	88 (52.07%)	–	81 (47.93%)
	TP	63 (47.73%)	35 (31.82%)	27 (20.45%)
Napoli IV	IU	76 (62.3%)	–	46 (37.7%)
	TP	74 (61.66%)	31 (25.83%)	15 (12.5%)

Figure



which are arranged according to the increasing strength of the female expression in the partners.

A 5th kind of cross $\delta\delta \times (\text{♀♀})$, has been carried out between males and oocyte carrying individuals which have been taken from mass cultures, and must therefore be regarded either as stable females or as inducible hermaphrodites.

Results of crosses 1, 4 and 5 only are available at the present stage of the research and sex ratios of the IU progenies (therefore male-female ratios only) obtained from the 3 different crosses in both the Venezia and Napoli IV strains are given in table 2.

Statistically highly significant differences are demonstrated between the varying strengths of the male and female sex expressions of the parental phenotypes and the sex ratios of their offspring. In fact type 1 crosses, where the male expression of the parents is the highest, give also the highest proportion of males in the progeny of both the Venezia and the Napoli IV strain. Type 4 cross, with the highest expression of the female factors in the pairs, produces the highest proportion of female progeny and the mixed crosses of

type 5, where pure females or female phase hermaphrodites have been introduced as egg bearing partners, give in both strains a number of female progeny which is consistently higher than in cross 1 where only hermaphrodites are present.

The following general conclusions can be drawn from the present experiments: 1. a new kind of hermaphroditism, the inducible hermaphroditism, is found among otherwise gonochoristic populations, which 2. is obtained through interactions between adult females – or female phase hermaphrodites – and juveniles. 3. The different crosses between inducible hermaphrodites, male and female individuals produce progenies whose sex ratios are correlated with the sex phenotypes of the parents. 4. Multiple sex genotypes, with different balances between male and female sex factors, are present in the populations, as well as in the mass cultures. 5. The variety of the sex phenotypes can be regarded as the result of the environmental interactions taking place between the different sex genotypes⁷ available in the sexual gene pools.

It is suggested that the existence of multiple sex genotypes capable of interacting with one another at the level of the sex expression enhances the probabilities of forming fertile pairs, especially in small, isolated populations.

Table 2

Strains	Crosses	Progenies Males	Females
Venezia	1 $\delta\delta \times \text{♀♀}$	60 (57.14%)	45 (42.86%)
	5 $\delta\delta \times (\text{♀♀})$	32 (45.71%)	38 (54.29%)
	4 $\text{♀♀} \times \text{♀♀}$	7 (22.58%)	24 (77.42%)
Napoli IV	1 $\delta\delta \times \text{♀♀}$	62 (67.39%)	30 (32.61%)
	5 $\delta\delta \times (\text{♀♀})$	59 (57.84%)	43 (42.16%)

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- 6 G. Bacci, in: Marine Organisms: Genetics, Ecology and Evolution, p.215. Plenum Press, New York, London 1978.
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Ketoconazole – a new broad spectrum orally active antimycotic¹

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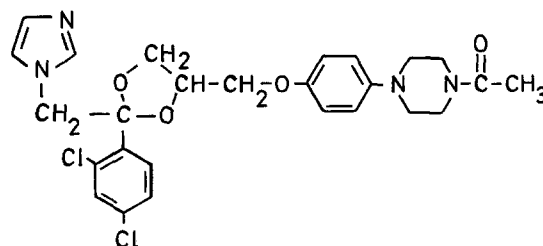
Summary. Oral treatment with ketoconazole prevented and cured artificial crop candidosis of the turkey, vaginal candidosis of the rat and skin candidosis of the guinea-pig. It was also highly effective against artificial systemic candidosis of the guinea-pig and chicken as well as against dermatophytoses of the guinea-pig.

We wish to report the discovery of a new orally active antimycotic agent with broad spectrum activity (table) against a wide variety of yeasts, dermatophytes and dimorphic fungi: ketoconazole (R 41400; figure) an imidazole derivative chemically related to miconazole²⁻⁴.

When administered for 10–14 days at dietary levels of 16–63 ppm corresponding to oral doses of 2.5–10 mg per kg b.wt, ketoconazole is effective against crop candidosis of young turkeys, the disease being induced by gavage into the crop of $4 \cdot 10^6$ cells of *Candida albicans* (strain B 12377 isolated from crop candidosis of a partridge) with final assessments made 14 days later. This prophylactic and therapeutic effectiveness is almost 100% from doses of 5 mg/kg onwards.

At oral doses of 2.5–10 mg/kg b.wt, ketoconazole is also capable of preventing and curing vaginal candidosis in ovariectomized and hysterectomized Wistar rats, kept in pseudopregnancy by weekly injections of 0.1 mg of oestra-

diol undecylate and infected intravaginally with $8 \cdot 10^5$ cells of *C. albicans* (strain B 2630 isolated from trush of a parrot). High prophylactic activity was also found against artificially induced skin candidosis in guinea-pigs⁵ at doses of 10 mg/kg b.wt, given orally for 14 days.



cis-1-acetyl-4-[2-(2,4-dichlorophenyl)-2-(1H-imidazol-1-ylmethyl)-1,3-dioxolan-4-ylmethoxy]phenyl]piperazine. (C₂₆H₂₈Cl₂N₄O₄; mol. wt 531.4). Serial number R 41400. Generic name ketoconazole.