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INTRODUCTION

In humans it is generally accepted that exposure to elevated levels of estrogens or corticosteroids leads to an increase in susceptibility to fungal infection. This effect is usually attributed to the hormonal action to impair host defenses. Several researchers have published studies indicating that other mechanisms may be operating.

The following charts represent the effect of the hormone milieu on various pathogens, as well as the possibility of the pathogen affecting the receptors of mammalian target organs.

ORGANISM	HORMONAL EFFECT	MECHANISM	SOURCE
Candida albicans	Binds estradiol and estrone.	Estrogen binding protein.	Madani et al Proc. Natl. Acad. Sci. USA Vol. 91, pp. 922-926 Feb. 1994
Candida albicans	Steroidal hormones increase resistance to azole antibiotics.	Mediated through R6G efflux.	Prasad, R et al J. Steroid Biochem Mol Biol 129 (1-2):61-9 March 2012
Candida albicans	Gene induction by progesterone.	Induces hyphae formation in yeasts.	Prasad, R et al J. Steroid Biochem Mol Biol 129 (1-2):61-9 March 2012
Candida albicans	Progesterone causes changes in cell transport, glycolysis, mitochondrial activity and transport proteins.	Upregulation of genes.	Prasad, R et al J. Steroid Biochem Mol Biol 129 (1-2):61-9 March 2012
C. albicans	Binds progesterone and corticosterone and 11-deoxycorticosterone.	Corticosteroid binding protein.	Madani et al Proc. Natl. Acad. Sci. USA Vol. 91, pp. 922-926 Feb. 1994 Skrowronski & Feldman, Endocrinolog 124 (4) 1965

ORGANISM	HORMONAL EFFECT	MECHANISM	SOURCE
Saccharomyces cerevisiae	Binds estradiol and estrone.	Estrogen binding protein	Madani et al Proc. Natl. Acad. Sci. USA Vol. 91, pp. 922-926 Feb. 1994 Skrowronski & Feldman, Endocrinolog 124 (4) 1965
Saccharomyces cerevisiae	Progesterone causes a stress response.	Upregulated genes affecting carbohydrate utilication, regulation, and transport.	Prasad, R et al J. Steroid Biochem Mol Biol 129 (1-2):61-9 March 2012
Paracoccidioides brasiliensis	Binds estradiol and estrone.	Estrogen binding protein.	Madani et al Proc. Natl. Acad. Sci. USA Vol. 91, pp. 922-926 Feb. 1994 Skrowronski & Feldman, Endocrinolog 124 (4) 1965
Trichophyton mentagrophytes	Binds progesterone.	Progesterone binding protein.	Madani et al Proc. Natl. Acad. Sci. USA Vol. 91, pp. 922-926 Feb. 1994 Skrowronski & Feldman, Endocrinolog 124 (4) 1965
Saccharomyces cerevisiae	Estrogen inhibits growth of organism.	Unknown	Madani et al Proc. Natl. Acad. Sci. USA Vol. 91, pp. 922-926 Feb. 1994 Skrowronski & Feldman, Endocrinolog 124 (4) 1965
P. Brasiliensis	Estrogen blocks the dimorphic conversion of the mycelial form to the invasive form.	Acts through cytosol binding protein in the fungus.	Loose et al Proc. Natl. Acad. Sci. USA Vol. 80, pp. 7659-7663 Dec. 1983
T. mentagrophytes	Progesterone inhibits growth of organism.	Unknown	Madani et al Proc. Natl. Acad. Sci. USA Vol. 91, pp. 922-926 Feb. 1994

ORGANISM	HORMONAL EFFECT	MECHANISM	SOURCE
C. albicans	Estradiol stimulates transition from yeast to hyphae forms.	Modulation of enzyme activity (NADPH oxidase) oxidoreductase.	Madani et al
C. albicans	Occupies estrogen receptor sites.	Endogenous lignan from **C. albicans** may modify host cellular function by interacting with steroid receptors in various target organs.	Loose, Schurman & Feldman Nature 293 (8) Oct. 1981
C. albicans	Luteal phase proliferation by progesterone. Follicular phase inhibition by progesterone. Infection maintained by estrogen administration to ovariectomized rats.	Inhibition of lymphocyte proliferation through a monocyte-dependent mechanism. Stimulates lymphocyte proliferation—production of interleukin I by monocytes. Absence of leukocytes cornified epithelium.	Kalo-Klein & Witkin Am. J. Obstet & Gynecol. Vol. 164, p. 1351 5/91 ibid. Kinsman & Collard Infection & Immunity pp. 498-504 Sept. 1986
C. albicans	Infection not promoted by progesterone administration in ovariectomized rats. Infection promoted by estrogen and progesterone together in ovariectomized rats.		Kinsman & Collard Infection & Immunity pp. 498-504 Sept. 1986 ibid.
C. albicans	LH increased germination of **C. albicans**	Possible stimulation of P450 conversion of precursor to yeast steroid involving transition to mycelial state.	Kinsman et al Mycoses, Vol. 31 (1988)
C. tropicalis **C. pseudotropicalis**	No activity with progesterone, i.e., no increase during pregnancy.	Yeast cytosols do not contain progesterone binding activity.	Powell & Drutz Journal of Infectious Diseases Vol. 147, No. 2 p. 359 Feb. 1983

ORGANISM	HORMONAL EFFECT	MECHANISM	SOURCE
C. pseudotropicalis	No activity with progesterone, .i.e., no increase during pregnancy.	Cytosols do not contain progesterone binding activity.	Powell & Drutz Journal of Infectious Diseases Vol. 147, No. 2 p. 359 Feb. 1983
Crytococcus neoformans	Unaffected by hormones.		Drutz et al Infection & Immunity pp. 897-907 May 1981
C. tropicalis	Unaffected by hormones.		Drutz et al Infection & Immunity pp. 897-907 May 1981
C. parapsilosis	Unaffected by hormones		Drutz et al Infection & Immunity pp. 897-907 May 1981
Petriellidium boydii	Unaffected by hormones.		Drutz et al Infection & Immunity pp. 897-907 May 1981
S. cerevisiae	Produces 17-β estradiol.	Extracted from cultures—binds with yeast binding and mammalian receptor sites.	Feldman et al. Proc. Natl. Acad. Sci. USA Vol. 81, pp. 4722-4726 August 1984
S. cerevisiae	Binds 17-β estradiol, estrone, progesterone, testosterone, corticosterone, aldosterone (affinity varies).	Binds to estradiol binding sites in yeast cytosol.	Feldman Science 218 15 Oct. 1982 p. 297
C. albicans	Interference with glucocorticoids.	Receptors bind glucocorticoids and binding or mammalian glucocorticoid receptors.	Sci. Vol. 225 (Feldman) p. 913 31 Aug. 1984

ORGANISM	HORMONAL EFFECT	MECHANISM	SOURCE
Coccidioides immitis	Yeast growth regulated by hormones of host—greatest virulence in pregnant women.	Contains sex hormone receptors.	Sci. Vol. 225 (Feldman) p. 913 31 Aug. 1984
	Estradiol, progesterone and testosterone stimulate yeast growth.	Stimulate maturation of parasitic endospores.	Kinsman et al Mycoses, Vol. 31 (1988)
	Exogenous estradiol and testosterone increases susceptibility (rats) to infection.	Unknown	Drutz et al Infection & Immunity pp. 897-907 May 1981

ANTIFUNGAL DRUGS	HORMONAL EFFECT	MECHANISM	SOURCE
Ketoconazole	Inhibits production and blocks activity of steroidal hormones.	Block production of cortisol and testosterone. Blocks human glucocorticoid receptors	Sci. Vol. 225 p. 913 31 Aug. 1984