Earliest fungal wall chemistry

1. Braconnot - 1811

Found there was always an alkali-resistant nitrogen-containing residue left after hot-alkali (1-6N KOH) treatment of mushrooms. However,less N than in protein. Named residue fungin.

2. Odier - 1825

Discovered novel N compound associated with insect exoskeleton. Named it **chitin**.

Same compound, but chitin* name stuck.

poly ß-1->4-N-acetylglucosamine

*Chitin = tanic

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Average chemical composition of fungal vegetative walls

1. Polysaccharides ~ 75-85%
   microfibrillar (main structural)
   nonmicrofibrillar (amorphous polysaccharides –
   less structural to nonstructural).

2. Protein ~ 10-15% (both structural* and enzymatic)

3. Lipid ~ 5-10% (structural)
   Also 1) pigments (usually small amounts, sometimes high)
   2) phosphate
   3) other inorganic ions
   4) polymerized organic acids (polyuronides).

*hydrophobins

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Other wall polysaccharides

1. Mannans - as mannoproteins*

2. S-glucans (soluble** α &/or ß glucans)

3. R-glucans (microfibrillar and nonmicrofibrillar ß glucans)

4. Numerous types of heteropolysaccharides

5. Various polyuronides (polymers of glucuronic &/or galacturonic acids)

6. Variety of aminopolysaccharides other than chitin or chitosan.

* Many studies in *S. cerevisiae*
** In strong alkali

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Why study fungal chitin?

1. Chitin is chemically unique and not found in human cells.

2. Chitin serves a vital role as a main structural component of fungal walls.

3. Chitin synthase substrate analogs inhibit fungal growth and sometimes lead to fungal deal

4. Fungal cell walls serve as main protective barriers between pathogen and host, so wall components including chitin should represent virulence factors

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"Review"
Polysaccharides of fungi and fungal-like protoctista

Microfibrillar polysaccharides

β(1->3) - (1->6) glucans (most of R glucan)
β(1->4) glucan = cellulose
β (1->4) N-acetylglucosamine = chitin

Very weakly microfibrillar polysaccharide

β(1->4) glucosamine = chitosan
other wall polysaccharides

also Mannans - as mannoproteins

S-glucans (mostly α, but some β glucans)

Heteropolysaccharides [mostly soluble in H_2O (HOT) and alkali (COLD), but some resistant (only soluble in hot alkali)]

Various polyuronides (polymers of glucuronic and galacturonic acids)

Various aminopolysaccharides other than chitin or chitosan – e.g., galactosamine polysaccharide

Mannoproteins

Why studied?

1. Main antigenic determinants of *S. cerevisiae* and most other fungi (particularly medically important fungi)

2. Can be altered by mutagenesis so structure-function relationships can be studied. e.g., How affect mating? How affect secretion?*

3. Microbial model for protein glycosylation via dolichol-p lipid intermediate

* many secreted fungal enzymes are glycosylated.

see OR 5 for details

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Fungal cell wall monosaccharides

Most fungi

1. D-glucose
2. N-acetylglucosamine
3. D-mannose

Monosaccharides with taxon association

4. D-galactose (Ascomycota)
5. D-galactosamine (")
6. L-fucose (Mucorales & Basidiomycota)
7. D-glucosamine (Mucorales)
8. D-xylose (Basidiomycota)
9. Uronic acids (Mucorales)
10. D-rhamnose (Ascomycota)*

*somewhat rare

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Monosaccharide correlations* for chitin/β-glucan group

Euascomycotina**
Homobasidiomycotina**
Chytridiomycota

	gal	gal-NH_2	fu	Xy
Euascomycotina	+	+	-	-
Homobasidiomycotina	-	-	+	+
Chytridiomycota	-	-	-	-

* Not known if will stand test of time
** & Fungi Imperfecti counterparts