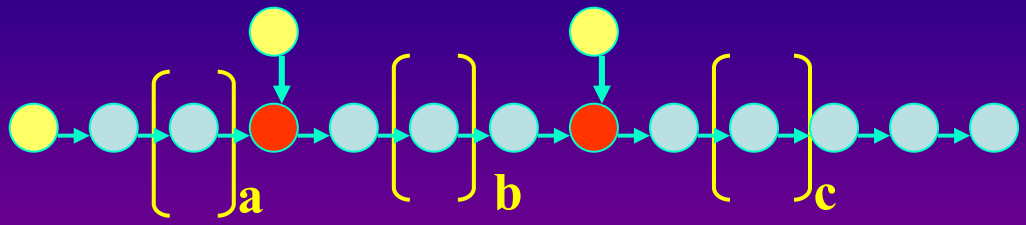
PIBOC Polysaccharide Collection

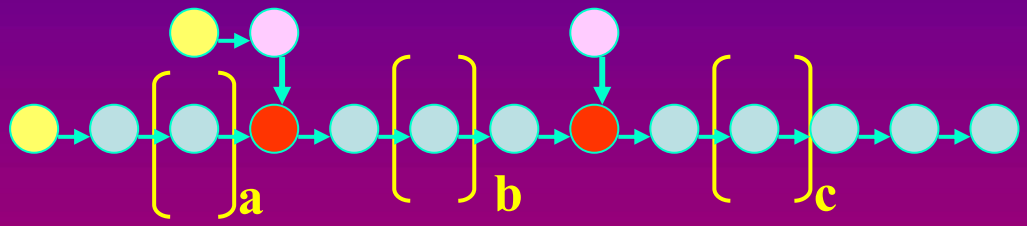
Laboratory of Enzyme Chemistry

1,3;1,6-β-D-Glucans



from *Laminaria cichorioides*

5 kDa

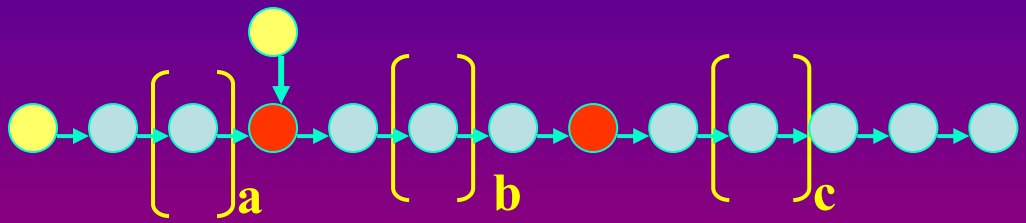


from *Fucus evanescens*

5 kDa

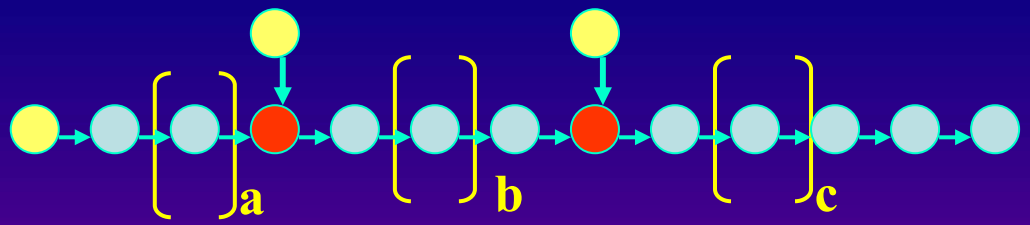
- nonsubstituted Glc residue
- 3-O-substituted Glc residue
- 3,6-O-di-substituted Glc residue
- 6-O-substituted Glc residue

1,3;1,6-β-D-Glucans



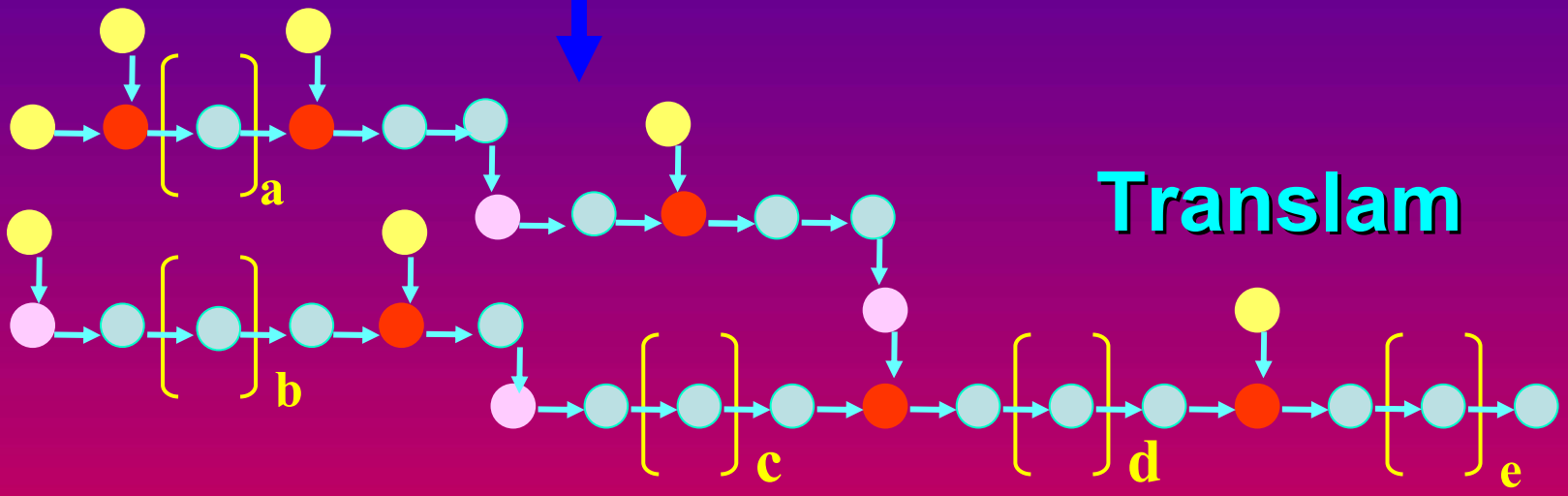
from *Laminaria guryanovae*

Molecular weight : 5-16 kDa



Laminaran from *Laminaria cichorioides*

1,3-β-D-glucanase from *Chlamys albidus*



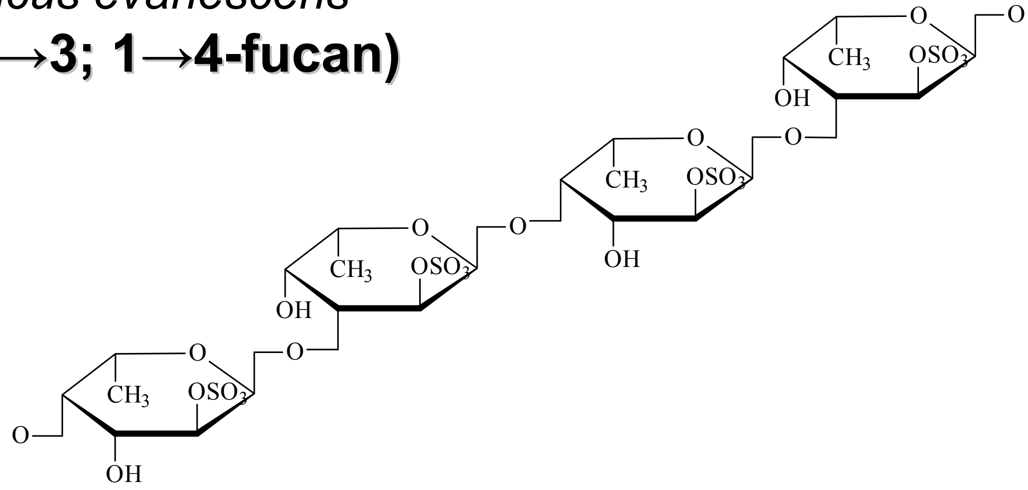
Translam

- 3,6-O-di-substituted Glc residue
- 3-O-substituted Glc residue
- 6-O-substituted Glc residue
- nonsubstituted Glc residue

8-10 kDa

Fucoidans

FUCOIDAN from
Fucus evanescens
(α-1→3; 1→4-fucan)



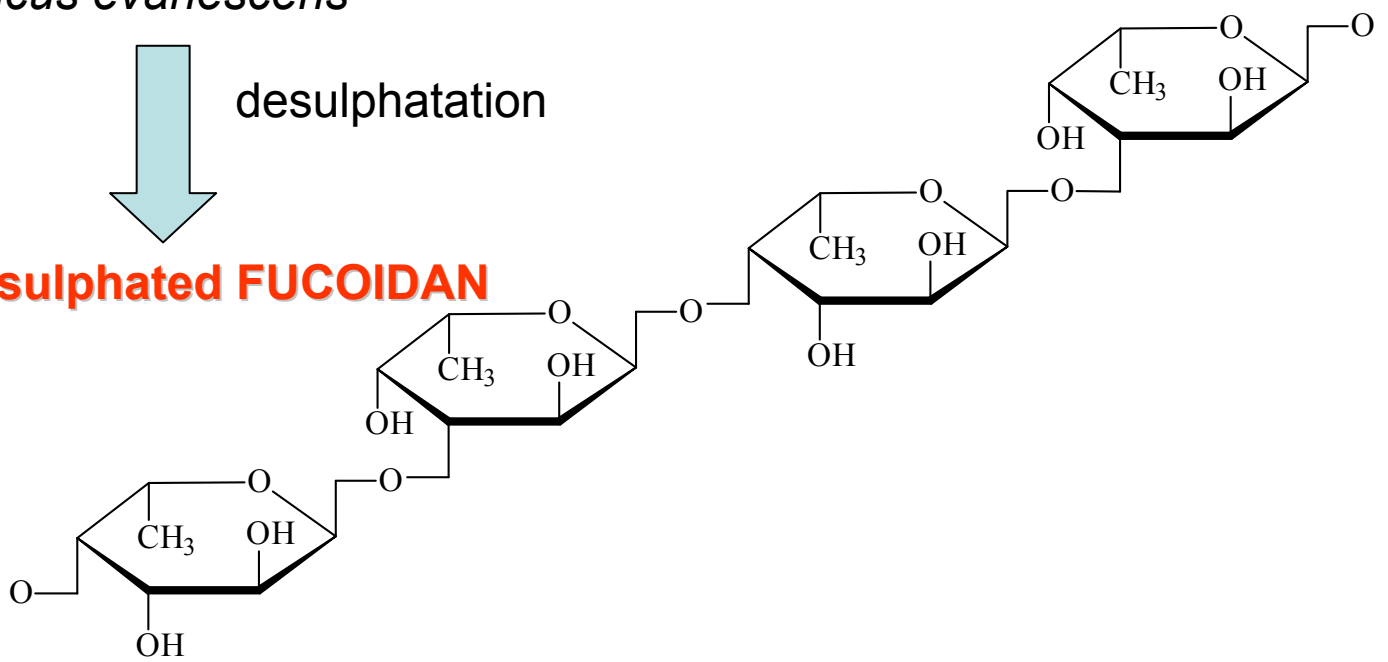
Molecular weight: 20-40 kDa
Fucose – 81 %
Fucose: SO_4^{2-} = 1:0.8

Fucoidans

FUCOIDAN from
Fucus evanescens

desulphatation

Nonsulphated FUCOIDAN

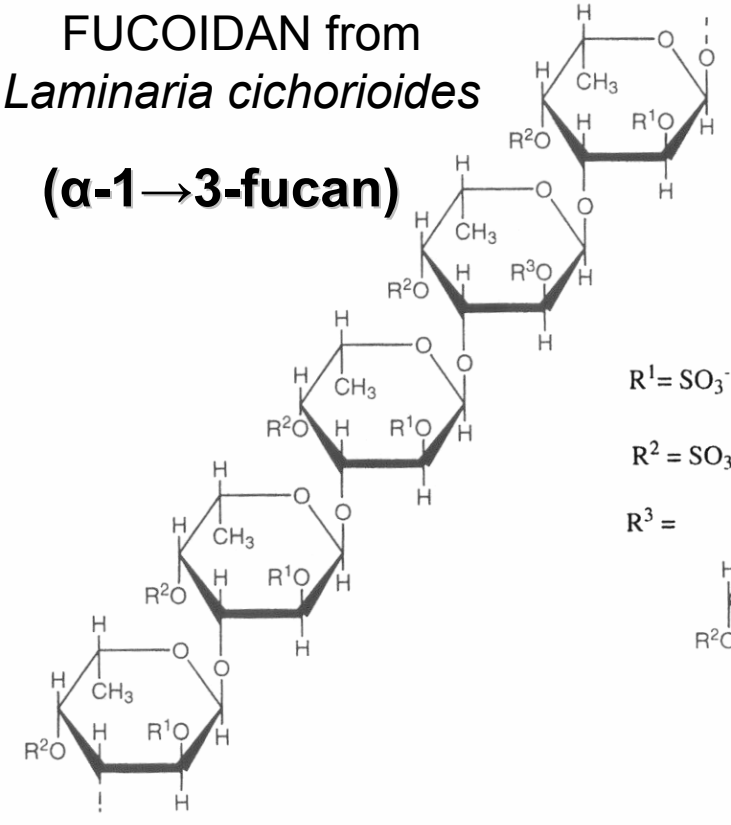


Fractions	Monosaccharide composition, % Fuc:Glc:Gal:Man:Xyl:Ram:GlcA	Level of sulphation, %
1	73:0:6:6:6.7:0:0	1.5

Fucoidans

FUCOIDAN from
Laminaria cichorioides

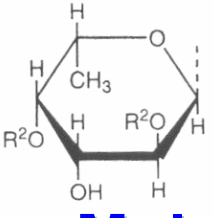
(α-1→3-fucan)



$R^1 = SO_3^-$ or H or $COCH_3$

$R^2 = SO_3^-$ or H

$R^3 =$

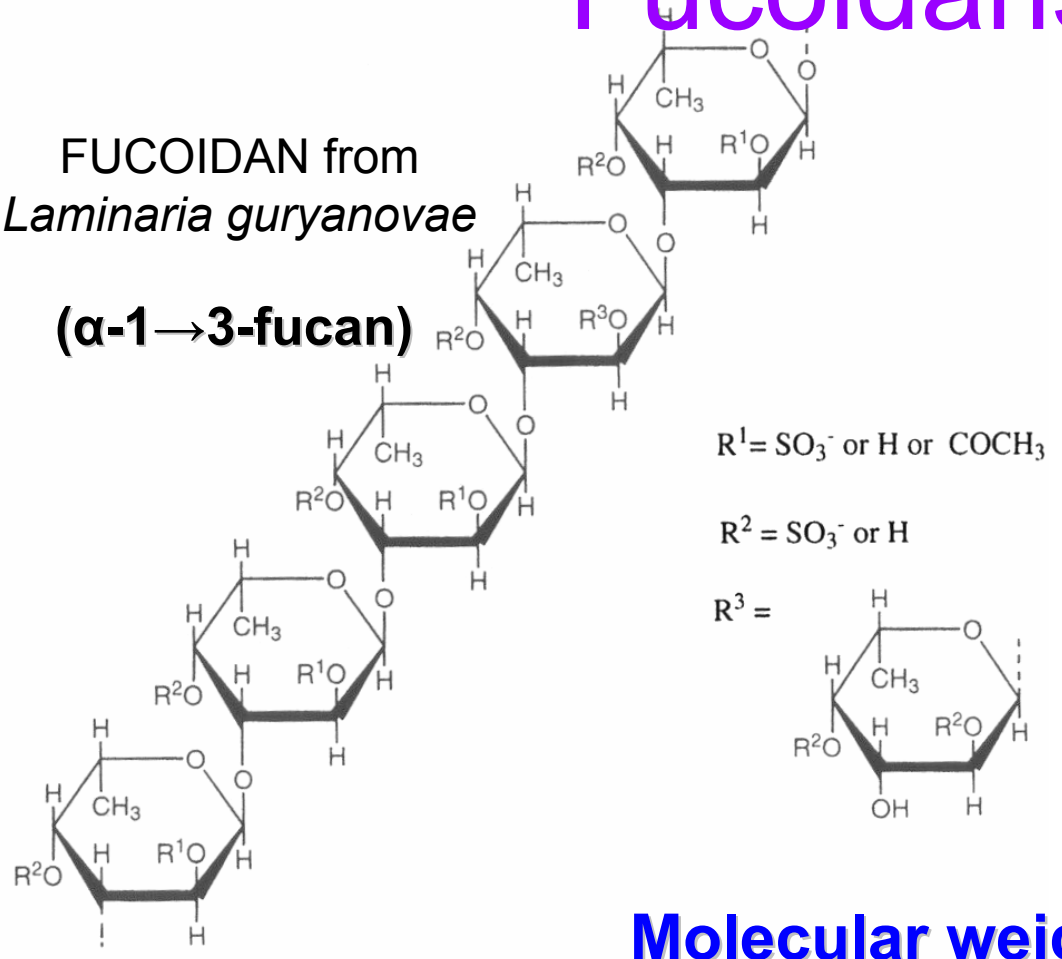


Molecular weight: 60-80 kDa
Fucose: 98%
Fucose:SO_4^{2-} = 1:1.7

Fucoidans

FUCOIDAN from
Laminaria guryanovae

(α-1→3-fucan)



$R^1 = SO_3^-$ or H or $COCH_3$

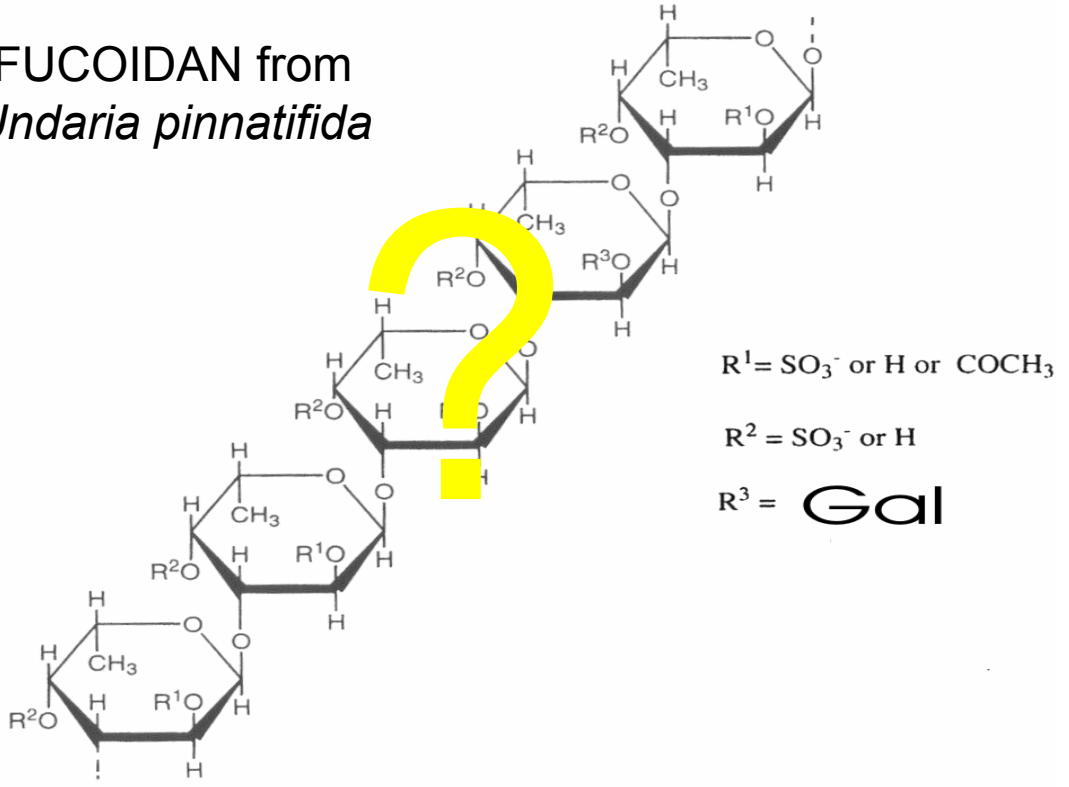
$R^2 = SO_3^-$ or H

$R^3 =$

Molecular weight: 20-50 kDa
Fucose – 96%
Fucose:SO_4^{2-} = 1:0.4

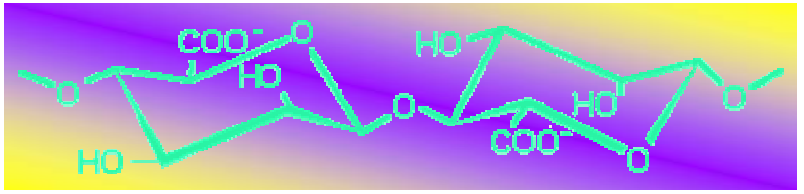
Fucoidans

FUCOIDAN from
Undaria pinnatifida



Fractions	Monosaccharide composition, % Fuc:Glc:Gal:Man:Xyl:Ram:GlcA	Fucose:SO_4^{2-}
1	55:0:45:0:0:0:0	1:0.7

Polymannuronic acids



M-block

Sources:

Alaria fistulosa

Fucus evanescens

Laminaria cichorioides

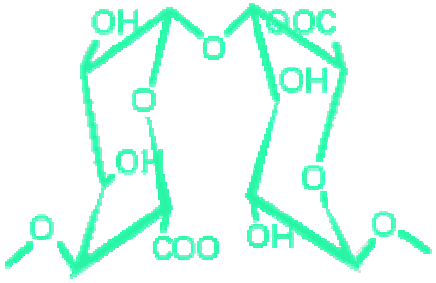
Molecular weight:

20kDa - 300 kDa

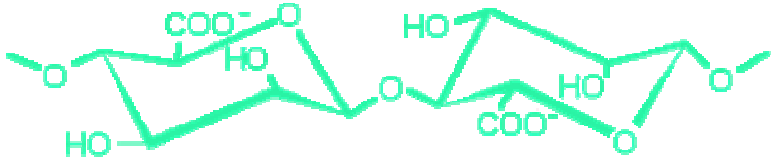
20 kDa-40 kDa

100-300 kDa

Alginic acids



G-block



M-block

Sources:	**Molecular weight**:	Ratio M and G-block
Alaria fistulosa	900 kDa	2.8:1
Fucus evanescens	900 kDa	1.0:1
Laminaria cichorioides	900 kDa	2.5:1
Undaria pinnatifida	900 kDa	3.0:1

Enzyme transformation of the FUCOIDAN

Fucoidans, highly sulfated polysaccharides of brown algae, posses diverse biological activities. The most interesting are antitumor, anticoagulant, and antiviral activities, *e.g.*, against HIV, hepatitis virus, and herpes virus. For the last decade, the structure of these polysaccharides has been extensively studied. A close correlation between structural characteristics of fucoidans and the taxonomy of the corresponding brown algae was hypothesized: it is known that a-(1,3)-L-fucans are found in *Laminaria*, whereas species of *Fucus* genus mainly contain α-(1,3, 1,4)-L-fucans.

Structure/ activity correlations for these polysaccharides are poorly studied. **Usually fucoidans have a high d. p., so depolymerisation is needed for medicinal applications.**

The enzymes degrading polysaccharides are widely used in structural studies, in studies of biological activities, and in preparation of drugs.

Enzyme transformation of the FUCOIDAN from *Fucus evanescens*

The products of enzymatic cleavage of fucoidans by fucoidanases

Enzyme (pH-optimum)	Substrate, m. wt, kDa	Characteristics			
		HMP, yields*, %	*n***	LMP, yields***, %	*n*
Acidic fucoidanase from *Littorina kurila* (5.4)	fucoidan from *F. evanescens*, 20-40	85	*n*>7	15	7>*n*>
	fucoidan from *L. cichorioides*, 60-80	95	*n*>7	5	7>*n*>
Basic fucoidanase from *L. kurila* (8.5)	fucoidan from *F. evanescens*, 20-40	55	*n*>7	45	7>*n*>
Fucoidanase from *P. citrea* KMM 3296 (7.2)	fucoidan from *F. evanescens*, 60-80	30	*n*>7	70	5>*n*>

HMP: highly molecular products obtained by precipitation with 80 % aqueous ethanol

Enzyme transformation of the FUCOIDAN from *Fucus evanescens*

The characteristics of low-molecular products of enzymatic cleavage of fucoidan from *F. evanescens* by action of fucoidanase from hepatopancreas of *L. kurila* and *P. citrea* KMM 3296

A source of enzyme	Products	Yield, % from the starting substrate	M. wt., kDa or *n**	Carbohydrate composition, %						Molar ratio Fuc :SO_4^{2-}
				Fuc	Gal	Xyl	Rha	Glc	Man	
Pseudoalteromonas citrea KMM 3296	P-1-Ps	26	5≥*n*≥2	96	4	0	0	0	0	1:0.31
	P-2-Ps	8	2-3	97.2	0.4	2.1	0.3	0	0	1:0.53
Hepatopancreas *Littorina kurila*,	P-1-L	30	3-10	92	1	1.8	0	2.5	3.7	1:0.59
	P-2-L	8	7≥*n*≥2	50	0	0	0	50	0	0
	P-1-1-L	17	3-10	92	1	1.8	0	2.5	3.7	1:0.59

**n*: degree of polymerization of products

Enzyme transformation of the FUCOIDAN from *Fucus evanescens*

The fucoidanases from the marine mollusk *L. kurila* and the marine bacterium *P. citrea* KMM 3296 have a similar specificity: they catalyze the predominant cleavage of α-(1→3)-glycosidic bonds between fucose residues in the polysaccharide. In contrast to fucoidanase from *L. kurila*, the bacterial fucoidanase cleaves fucoidan forming mainly di-, tri-, tetra-, and pentafucooligosaccharides, whereas the action of the basic form of fucoidanase from *L. kurila* yields higher molecular weight products of 3-10 kDa.

Probably, these differences are related to structural peculiarities of active centers of enzymes and the mechanism of action of the enzymes on the polymer substrate.