Appendix 5: IMO Typical composition

Saccharide distribution in IMOs

Degree of Polymerisation	Saccharides	CAS No.	Chemical Formula	Chemical Name	Typical IMOs	COFCO IMO	Bioneutra
DP1 (Monosaccharldes)					0-5	0-5	0-5
	Glucose	50-99-7	$C_6H_{12}O_6$	D-Glucose			
DP2 (Disaccharides)					15-40	20-38	18-35
	Maltose	69-79-4	$C_{12}H_{22}O_{11}$	4-O-α-D-glucopyranosyl-D-glucose			
	Isomaltose	499-40-1	$C_{12}H_{22}O_{11}$	6-O-α-D-glucopyranosyl-D-glucose			
DP3 (Trisacchandes)					5-55	20-30	20-32
	Maltotriose	1109-28-0	$C_{18}H_{32}O_{16}$	O-α-D-glucopyranosyl-(1,4)-O-α-D-glucopyranosyl-(1,4)-D-glucose			
	Pannose	33401-87-5	$C_{18}H_{32}O_{16}$	O-α-D-glucopyranosyl-(1,6)-O-α-D-glucopyranosyl-(1,4)-D-glucose			
	Isomaltotriose	3371-50-4	$C_{18}H_{32}O_{16}$	O-α-D-glucopyranosyl-(1,6)-O-α-D-glucopyranosyl-(1,6)-D-glucose			
Oligo- and polysaccharides (DP4 to DP9)							
DP4					0-30	14-22	14-22
	Maltotetraose	34612-38-9	$C_{24}H_{42}O_{21}$	O-α-D-glucopyranosyl-(1,4)-O-α-D-glucopyranosyl-(1,4)-D-glucose			
DP5					0-30	5-7	6-8
	Maltopentaose	34620-6-3	$C_{30}H_{52}O_{26}$	O-α-D-glucopyranosyl-(1,4)-O-α-D-glucopyranosyl-(1,4)-O-α-Dglucopyranosyl-(1,4)-O-α-D-glucopyranosyl-(1,4)-D-glucose			
DP6					0-10	4-7	3-6
	Maltohexaose	34620-77-4	$C_{36}H_{62}O_{31}$	O-α-D-glucopyranosyl-(1,4)-O-α-D-glucopyranosyl-(1,4)-O-α-Dglucopyranosyl-(1,4)-O-α-D-glucopyranosyl-(1,4)-O-α-Dglucopyranosyl-(1 -4)-D-glucose			
DP7					0-10	3-4	2-3
	Maltoheptaose	1980-14-9	$C_{42}H_{72}O_{36}$	O-α-D-glucopyranosyl-(1,4)-O-α-D-glucopyranosyl-(1,4)-O-α-Dglucopyranosyl-(1,4)-O-a-D-glucopyranosyi-(1,4)-O-a-Dglucopyranosyl-(1,4)-Oα-D-glucopyranosyl-(1,4)-D-glucopyranose			
DP8							
	Maltooctaose	6156-84-9	$C_{48}H_{82}O_{41}$	O-α-D-glucopyranosyl-(1,4)-O-α-D-glucopyranosyl-(1,4)-O-α-Dglucopyranosyl-(1,4)-O-α-D-glucopyranosyl-(1,4)-O-α-Dglucopyranosyl-(1,4)-O-α-D-gucopyranosyl-(1,4)-O-α-Dglucopyranosyl-(1,4)-D-glucose			
DP9							
	Maltononaose	6471-60-9	$C_{54}H_{92}O_{46}$	O-α-D-glucopyranosyl-(1,4)-O-α-D-glucopyranosyl-(1,4)-O-α-Dglucopyranosyl-(1,4)-O-α-D-glucopyranosyl-(1,4)-O-α-Dglucopyranosyl-(1,4)-O-α-D-glucopyranosyl-(1,4)-O-α-Dglucopyranosyl-(1,4)-O-α-D-glucopyranosyl-(1,4)-D-glucose			

References

BioNeutra Expert Panel Report concerning the Generally Recognised as Safe (GRAS) status of VITASUGAR™, as an isomalto-oligosaccharide (IMO) mixture for use in foods (2008).

BioNeutra Application for the Approval of IMO under regulation (EC) No 258/97 of the European Parliament and of the Council of 27th January 1997 concerning novel foods and novel food ingredients (2008).

DP distribution (as %) of IMO materials identified in referenced studies

Study Reference	DP1	DP2	DP3	DP4	DP5	DP6	>DP6
Chen et al 2001, Wang et al 2001	21.4	17.4	35.6	13.1			2.5
Day and Chung 2004	<0.2	6.9	28.4	36.7	19.1	7.4	1.2
Kaaneko et al 1990		38	25.2	23.7			
		52.5	25.4	15.2			
Kaneko et al 1992		34.4	26.9	16.2			10.6
Oku and Nakamura 2003	3.8	40.4	29.2	17.7	7.2	1.7	
Kaneko et al 1995	3.8	40.4	29.2	17.7	7.2	1.7	
	0.4	88.7	10.4	0.5			
	0.5	5.4	44	30.7	8.5	10.9	
Kohmoto et al 1998	1.8	57.6	25.4	15.2			
Kohmoto et al 1991	2.4	72.1		21.4			
Kohmoto et al 1992	1.2	41.5	30.3	15.5	6.9	4.6	

APPENDIX 5: IMO Comparisons

Compositional parameters for BioNeutra GRAS IMO and COFCO IMO; China National Standard and Korean Food Code

PARAMETER		COFCO	BIONEUTRA
Compositional	**Description**		
		IMO is a mixture of glucose oligomers with α-(1,6)-glucose linkages such as isomaltose, panose, isomaltotriose, isomaltopentose and higher branched oligosaccharides. The major components of IMO mixtures are disaccharide (Isomaltose, DP2) and trisaccharide	BioNeutra IMO (Vitasugar^{TM}) is a mixture of glucose oiligomers with alpha-(1-6)-linkages such as isomaltose, panose, isomalotriose and isomaltopentose. The majority of glucose oligosaccharides found in IMO consist of 3-6 monosaccharide units linked together, however disaccharides as well as longer polysaccharides (up to 9 units) are also present.
Source raw material			
	Plant origin	Corn/Maize	Commonly available cereal crops – barley, corn, oats, rice and other starch sources such as cassava, potato and pulses
Degree of polymerisation	DP1	0 - 5	0 - 5
	DP2	20 - 38	18 - 35
	DP3	20 - 30	20 - 32
	DP4	14 - 22	14 - 22
	DP5	5 - 7	6 - 8
	DP6	4 - 7	3 - 6
	Other	3 - 4	2 - 3
Process of Manufacture		Starch is enzymically hydrolyzed, using amylases and pullulanse to produce a high maltose syrup, which is further treated with transglycosidase, a food grade enzyme listed in Standard 1.3.3, resulting in enzymatic conversion of α (1, 4) glycosidic linkages into α (1,6) glycosidic linkages. This is followed by a controlled yeast fermentation to remove mono and disaccharides, resulting in a product rich in isomalto-oligosaccharides.	Isomalto-oligosaccharide is formed by enzyme-catalyzed hydrolysis of starch from different cereal crops (wheat, barley, corn), pulses (lentils, peas), rice, tapioca (cassava), potato and other starch sources. Enzymes, including alpha-glucosidase, alpha-amylase, and pullulanase, hydrolyse the polysaccharides in starch to produce mono-, di-, tri-, and other smaller oligosaccharides with alpha-1,4 and alpha-1,6 glycoside linkages. Yeast is added to remove glucose that may be formed as a result of the enzymatic hydrolysis reactions. The final step in the starch hydrolysis is a saccharification step that yields high maltose syrup. Maltose syrup naturally contains di- and tri- oligosaccharides with alpha- 1,4 glycoside linkages. In order to convert these molecules into functional and low caloric molecules, these alpha-1,4 linkages are enzymatically converted into alpha-1,6 linkages, thus forming IMO. This step is achieved by the addition of an enzyme, transglucosidase (TG). To summarize, the TG enzyme converts malto-oligosaccharides to IMO.[Health Canada dossier]