

# Sweeteners, High-Intensity

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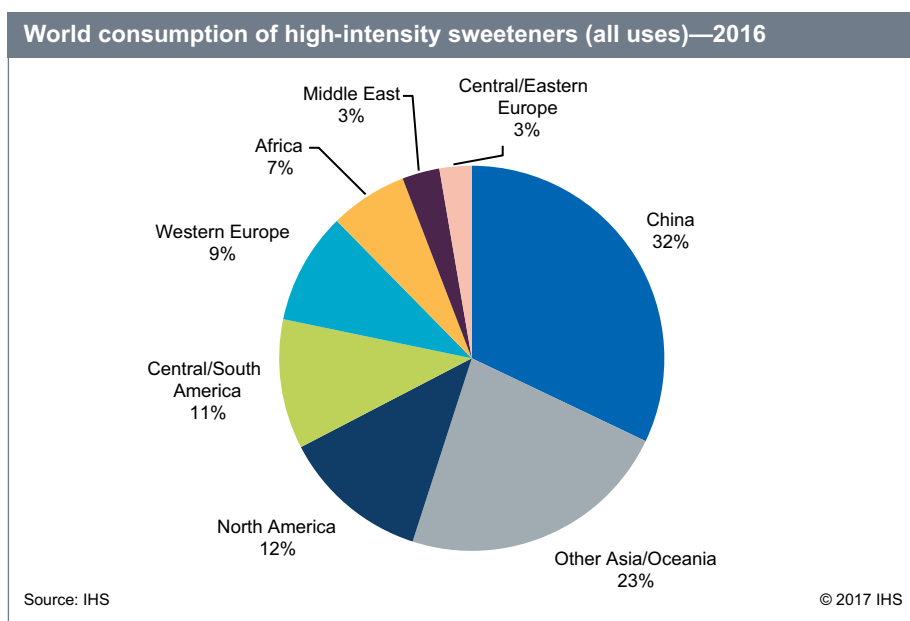
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## Abstract

High-intensity sweeteners (HIS) are a structurally diverse set of compounds that share an important attribute: all are much sweeter than sucrose (table sugar). Unlike sugar, HIS are noncaloric and noncariogenic (they do not contribute to dental caries). Most HIS—including acesulfame K, aspartame, cyclamate, saccharin, and sucralose—are artificial sweeteners, produced by chemical synthesis; a few, including stevia extract, are natural products.

Worldwide consumption of HIS is largely dependent on production of diet carbonated soft drinks and food. Beverages make up the majority of world HIS consumption, followed by food, tabletop sweeteners, personal care products (such as toothpaste and mouthwash), and pharmaceuticals.

The following pie chart shows world consumption of high-intensity sweeteners in 2016:



The following table shows the relative sweetness of various high-intensity sweeteners relative to sucrose (table sugar), which is the “gold standard” of sweetness (sugar or sucrose = 1):

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### Relative sweetness of high-intensity sweeteners

Sweetener	Relative sweetness <sup>a</sup>
Acesulfame K	200
Advantame	20,000
Aspartame	200
Cyclamate	30
Glycyrrhizin	50
Monk fruit extract	150
Neohesperidin dihydrochalcone	1,500-1,800
Neotame	8,000
Saccharin	300
Stevia extract <sup>b</sup>	200
Sucralose	600
Thaumatococin	2,000-3,000

a. Relative sweetness versus table sugar or sucrose (sucrose = 1). Sweetness is dependent on several factors, including the concentration of sweetener, temperature, pH, type of medium, and the concentration of the sucrose solution used as a comparison.

b. Rebaudioside A and stevioside are the principal sweetening constituents of stevia extract.

Source: Calorie Control Council, 2014.

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The outlook for high-intensity sweetener consumption during 2016–21 varies by region and by sweetener. Demand for mature HIS—cyclamate, saccharin, and aspartame—is flat or declining in North America and Western Europe although consumption continues to increase in Asia, the Middle East, and Africa. In contrast, consumption of acesulfame K, sucralose, and stevia extract is growing in all regions.

Cyclamate was the leading sweetener in terms of consumption volume, responsible for almost half of global HIS consumption in 2016. Because cyclamate is only 30 times as sweet as sucrose, however, it accounted for just 10% of sucrose equivalents. Saccharin, which is 300 times as sweet as sucrose, was third with respect to consumption volume but first in terms of sucrose equivalents. Saccharin accounted for 37% of total sucrose equivalents in 2016.

Developing regions, including notably Asia and Africa, accounted for the bulk of world cyclamate consumption in 2016. The use of cyclamate—the least expensive high-intensity sweetener—in these regions has increased as diet beverages and food have become more popular for health reasons. Africa and Asia are among the regions that expect to see above-average growth in cyclamate consumption during 2016–21. In contrast, cyclamate consumption is predicted to decrease in the Americas and Europe. (Cyclamate use in foods is prohibited in the United States, Japan, and South Korea.)

The Americas accounted for more than 40% of world aspartame consumption in 2016, with demand driven largely by diet soft drink production. Ongoing declines in soft drink consumption and consumer concerns about the sweetener's safety will lead to declines in North America and Western Europe during 2016–21. In contrast, aspartame consumption is expected to grow at above-average rates in Central and South America, China, Other Asia and Oceania, Africa, and the Middle East. Aspartame accounts for approximately 18% of the world consumption of HIS (sweetening uses only).

Asia accounted for more than half of world saccharin consumption in 2016. Saccharin is a mature product with a broad range of uses. It serves as a sugar replacement in foods and beverages; in addition, its sweetness masks the bitter taste of other ingredients in personal care products (toothpaste, mouthwash) and pharmaceuticals. Smaller end uses include animal feed and electroplating. China, Other Asia and Oceania, Africa, and the Middle East are expected to see above-average growth in saccharin consumption during 2016–21. In contrast, saccharin consumption is predicted to decrease in the Americas and Europe. Saccharin accounts for approximately 18% of the world consumption of HIS (sweetening uses only).

Asia and the Americas were responsible for the bulk of world acesulfame K consumption in 2016. Acesulfame K is typically used in combination with aspartame and sucralose; acesulfame K/aspartame and acesulfame K/sucralose blends have very appealing sucroselike taste profiles. All regions are expected to see positive consumption growth during 2016–21, with especially vigorous growth in China and Central and South America. Acesulfame K accounts for approximately 9% of the world consumption of HIS (sweetening uses only).

North America was the single largest consumer of sucralose in 2016, followed by China. Sucralose, which is 600 times as sweet as sucrose, has an appealing sugarlike taste profile. All regions are expected to see increases in consumption during 2016–21, with especially vigorous growth (from a very small base) in Africa and the Middle East.

The Americas and Asia accounted for most of the consumption of stevia extract in 2016. The stevia plant, which is the source of stevia extract, is indigenous to South America; today, however, the bulk of cultivation takes place in China. Japan, China, and other Asian countries have long used stevia extracts as sweeteners; European, Middle Eastern, and African markets for this sweetener are comparatively developmental. Consumption of stevia extract is expected to increase at a higher rate than that of other HIS during 2016–21, largely because of consumer preferences for natural sweeteners.

# Contents

<b>Executive summary</b>	<b>7</b>
<b>Summary</b>	<b>9</b>
HIS as sucrose replacements	10
Consumption of major HIS	14
Cyclamate	14
Saccharin	16
Aspartame	17
Acesulfame K	19
Sucralose	20
Stevia extract	22
Outlook	24
<b>Introduction</b>	<b>26</b>
Acesulfame K	26
Advantame	26
Aspartame	27
Cyclamate	27
Glycyrrhizin	27
Monk fruit extract	28
Neohesperidin dihydrochalcone	28
Neotame	29
Saccharin	29
Stevia extract	30
Sucralose	31
Thaumatococin	31
<b>Manufacturing processes</b>	<b>32</b>
Acesulfame K	32
Aspartame	32
Cyclamate	33
Glycyrrhizin	34
Monk fruit extract	34
Saccharin	34
Toluene or R-F process	34
Phthalic anhydride process	35
Stevia extract	37
Sucralose	37
<b>Regulatory status</b>	<b>39</b>
United States	39
Acesulfame K	39
Advantame	40
Aspartame	40
Cyclamate	40
Glycyrrhizin	41
Monk fruit extract	41
Neotame	41

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Saccharin	41
Stevia extract	41
Sucralose	41
Canada	42
Mexico	42
Western Europe	43
Japan	44
China	45
<b>Supply and demand by region</b>	<b>47</b>
United States	47
Producing companies	47
Production	48
Consumption	48
Aspartame	51
Beverages	52
Tabletop sweeteners	54
Food and other	55
Saccharin	55
Personal care products	57
Tabletop sweeteners	57
Industrial applications	57
Beverages	57
Food	58
Other	58
Acesulfame K	58
Beverages	59
Food, tabletop sweeteners, and other	60
Sucralose	60
Beverages	61
Tabletop sweeteners	61
Food and other	61
Stevia extract	62
Cyclamate	63
Other	64
Price	65
Acesulfame K	65
Aspartame	66
Cyclamate	66
Saccharin	67
Trade	67
Imports	68
Aspartame	68
Saccharin	68
Acesulfame K	70
Stevia extract	70
Cyclamate	71
Glycyrrhizin	71
Sucralose	72
Exports	72
Aspartame	73
Saccharin	74
Sucralose	74
Cyclamate	75
Canada	75

Salient statistics	76
Consumption	76
Trade	77
Aspartame	78
Saccharin	78
<b>Mexico</b>	<b>80</b>
Producing companies	80
Salient statistics	80
Consumption	81
Trade	82
Aspartame	82
Saccharin	83
<b>Central and South America</b>	<b>83</b>
Producing companies	84
Salient statistics	84
Consumption	85
Trade	87
Aspartame	87
Cyclamate	88
Saccharin	89
Stevia extract	89
<b>Western Europe</b>	<b>90</b>
Producing companies	90
Production	93
Acesulfame K	93
Aspartame	94
Cyclamate	95
Neohesperidine dihydrochalcone	95
Saccharin	95
Stevia extract	95
Sucralose	96
Thaumatococin	97
Consumption	97
Acesulfame K	100
Aspartame	101
Cyclamate	102
Neohesperidine dihydrochalcone	103
Saccharin	103
Steviol glycosides	104
Sucralose	105
Thaumatococin	106
Price	107
Trade	108
Acesulfame K	108
Aspartame	108
Cyclamate	109
Saccharin	110
<b>Central and Eastern Europe</b>	<b>111</b>
Salient statistics	111
Acesulfame K	112
Aspartame	112
Cyclamate	113
Saccharin	113
Consumption	114

Trade	115
<b>Middle East</b>	<b>115</b>
Producing companies	116
Salient statistics	116
Acesulfame K	116
Aspartame	117
Cyclamate	117
Neohesperidin dihydrochalcone	118
Saccharin	118
Consumption	119
Trade	119
<b>Africa</b>	<b>120</b>
Salient statistics	120
Acesulfame K	121
Aspartame	121
Cyclamate	122
Saccharin	122
Consumption	123
Trade	124
<b>Japan</b>	<b>124</b>
Producing companies	124
Salient statistics	127
Consumption	128
Acesulfame K	129
Aspartame	130
Licorice extracts and glycyrrhizin	130
Saccharin	131
Stevia extract	132
Sucralose	132
Other	133
Price	133
Trade	133
Acesulfame K	133
Aspartame	134
Licorice extracts	134
Saccharin	135
<b>China</b>	<b>137</b>
Producing companies	137
Salient statistics	140
Consumption	141
Acesulfame K	142
Aspartame	143
Cyclamate	143
Glycyrrhizin	144
Saccharin	144
Stevia extract (stevioside, reb A)	145
Sucralose	146
Price	146
Trade	146
<b>Indonesia</b>	<b>149</b>
Producing companies	149
Salient statistics	150
Consumption	150
Price	151

Trade	152
South Korea	152
Producing companies	152
Salient statistics	153
Consumption	154
Trade	155
Other Asia and Oceania	155
Producing companies	155
Consumption	156
Price	158
Trade	158
<b>Bibliography</b>	<b>160</b>



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