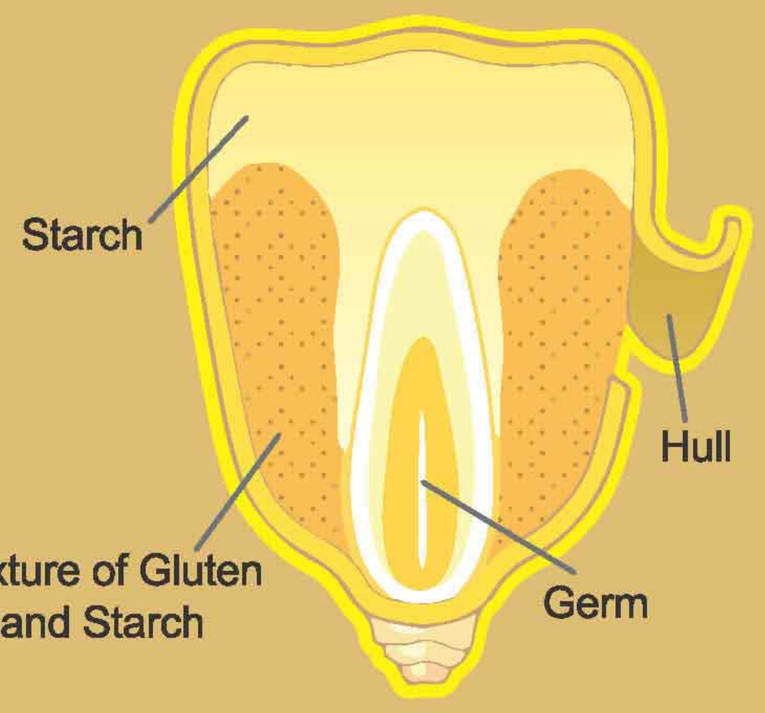
Zar Fructose

Zar Grain Refinery

Grain Bio Refinery

Grain Bio Refinery can be considered as a leading industry in the sector of high value-added alterant industries. In this industry, all parts of grain such as starch, germ and hull can be utilized for the production of high value-added bio products such as fructose and glucose syrups, maltodextrin, various native and modified starches, ethanol, germ oil, carbon dioxide, and various livestock and poultry feed.



Products of maize-based Grain Bio Refinery

- Various starches (native and modified).
- Sweeteners made from maize starch. (fructose, glucose, and maltose syrups)
- Maize oil (rich in polyunsaturated fatty acids).
- Livestock and poultry feed (maize hull, maize gluten, corn steeping liquor, maize germ pulp).
- Other bio products including ethanol, amino acids, antibiotics, vitamins, biodegradable plastics and etc..

Zar Fructose

Corn

Wet milling

- Sweeteners
  - Fructose → Beverage Industry, Bakery Industry, Dairy industry, Jams and sauces
  - Glucose → Bakery Industry, Jams, Chewing gums, Sauces
  - Maltose → Beverages
  - Maltodextrin → Instant soups, Infant formula, Sport supplements
- Starch
  - Native
    - Industrial products → Adhesives, Paper industry, Textile
    - Food products → Infant formula, Bakery products, Snacks
  - Modified
    - Industrial products → Adhesives, Paper industry, Textile, Drilling fluid
    - Food products → Sauces, Dairy products, Soups
- Gluten Feed → Livestock feed
- Germ → Oil extraction
  - Pulp → Livestock feed and industrial products
  - oil → Industrial products, Food products
- Gluten → Livestock feed

Dry milling

- Fermented products
  - DDGS → Livestock feed
  - Bioethanol
- Germ
  - Pulp → Livestock feed and industrial products
  - Oil → Industrial products, Food products
- Flour → Food Products → Bakery products, Snacks, Infant formula, Biscuit dough, Breakfast cereal
- Cornmeal → Food Products → Breakfast cereal, Fortified cereals, Snacks, Bakery products, Fermented beverages

Zar Grain Refinery: The First Grain Refinery and Dry Port of Iran

In accordance with the concept of Resistive Economy, a super project with various sectors of development was started close to Tehran and the preliminaries of the largest grain refinery in Middle East and the first grain refinery in Iran were established.

The first phase of this Refinery was started in president Rouhani's presence in December, 2016. Due to the advantages of raw material supply and strategic geographical location, this Refinery can process thousands of tons of cereal and produce raw materials of other food and drug industries.

Unique properties of Zar Grain Refinery

- Acting as a dry port;
- Located at the transit crossing of the country;
- Access to the railroad network;
- Possessing Silos with the capacity of one million tons of grain storage;
- Possessing Silos in Amirabad, Nowshahr and Anzali ports located at the North of Iran and Imam Khomeini port located at the south of Iran;
- Having countrywide transportation and distribution systems.

Zar Fructose plants

Zar Fructose plants are companies of Zar Grain Refinery. The first outlet of these plants is starch. Depending on the target purpose, this product can be sold either as its native or modified forms. The produced starch can be used as a raw material for the production of sweeteners. These natural sweeteners include various fructose, glucose and other syrups. Products of this company are supplied to the market based on the advantages of being high quality, safety and lower price.

Liquid Sweeteners

Starch based sweeteners

Corn contains a high amount of starch, which is a polysaccharide that is made from glucose monosaccharide. Depending on the extent of hydrolysis, various products are obtained from the hydrolysis of starch. The extent of hydrolysis is expressed by a parameter called DE (Dextrose Equivalent - content of reducing sugar). The first product of hydrolysis is called maltodextrin, which has a DE value of lower than 20. By further hydrolysis and consequently increase in DE, glucose syrups are obtained. The properties of glucose syrups and therefore their applications depend on the degree of hydrolysis. Glucose syrups with DE of higher than 95 can be used for the production of fructose syrup. The process of converting parts of glucose to fructose was first discovered in 1970. The product of this process is called high fructose corn syrup (HFCS).

There are various commercial HFCS products, which vary in terms of glucose to fructose ratio. Among these, the most common products are HFCS42 and HFCS55 which, have 42 and 55% of fructose on dry basis, respectively. Therefore, despite the name, it does not have a higher fructose proportion in comparison with sucrose. In 1983, FDA confirmed HFCS as a GRAS which was reconfirmed in 1996.

Chemical composition of fructose syrup and sucrose is similar and they both are made from glucose and fructose monosaccharides, but in sucrose these molecules are binded together while in fructose syrup these molecules are present as free monosaccharides. Fructose syrup and sucrose have identical sweetness and their digestion is similar. In sucrose, the glycoside linkage between glucose and fructose is broken during digestion and these monosaccharaides are absorbed through intestine. In fructose syrup, these monosaccharides are present in their free form, therefore their absorption takes place without further breakdown in digestive system. In acidic environments like carbonated beverages, jams, sauces and etc. sucrose is broken down into glucose and fructose.
Syrups obtained from corn have a broad application in the food industry. Today, traditional acidic and acid-enzyme hydrolysis methods of producing corn syrups have been replaced with enzyme-enzyme method. In this regard, various corn syrups with different sugar profile and functional properties can be obtained. Maltose syrup is another sweetener that can be obtained. Maltose is a disaccharide which is made of two glucose molecules and has a specific taste with a mild sweetness with many applications in beverage, bakery and other industries.

BASIC SWEETNESS OF GLUCOSE SYRUPS

Zar Grain Refinery produces a large quantity of various corn syrups in a year:

- Corn syrup containing 10-90 % fructose.
- Glucose syrups with dextrose equivalent (DE) of 20-95.
- High maltose corn syrups.
- Maltodextrin

Continuous production of high quality products is the main policy of Zar Grain Refinery

Today, the quality of products is an important factor for consumers. The quality of the final products will determine the extent of the consumer's trust to a company. Therefore, Zar Fructose Co. has always considered this fact and has done its best to produce its products with the highest quality by means of up to date technologies. To achieve this, a precise quality control from raw materials to the final products should be considered. Among producers, food and drug industries must apply a strict quality control to their final products. In this regard, products of Zar Grain Refinery such as starch, maltodextrin, glucose syrups, maltose syrups, and fructose syrups are produced with a very strict quality control due to their final use in many sectors of food and drug industries.

In order to produce a high quality product, industries should take advantages of advanced technologies, up to date knowledge, experienced experts, and highly equipped laboratories. The personnel of the production, laboratory and quality control sections of Zar group are well trained and keep their knowledge up to date and by participating in national and international exhibition and assistance of national and international experienced consultants are manufacturing products which are in accordance with the global standards.

This has led to the exportation of Zar Refinery Co.'s products to many countries.

Zar Fructose

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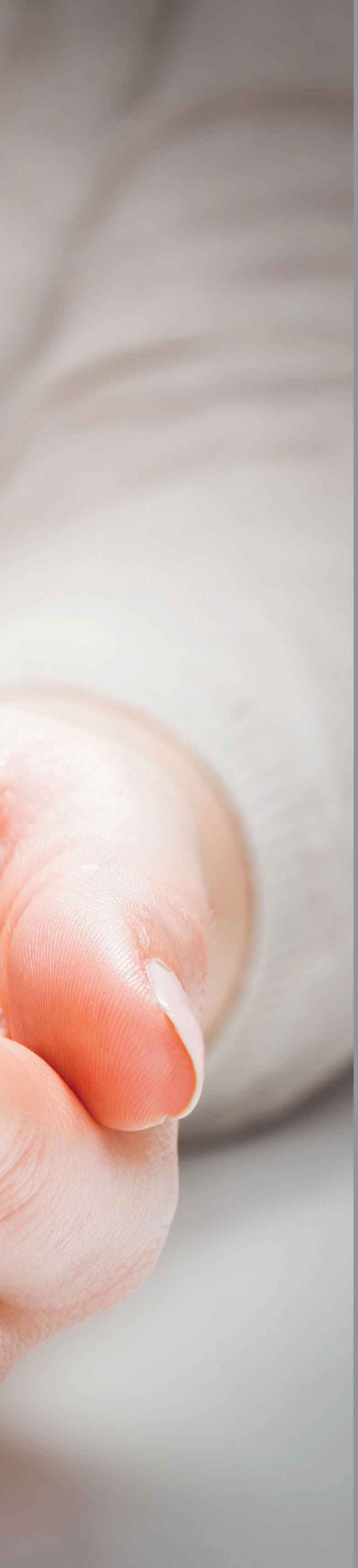
HFCS



High fructose corn syrup

High fructose corn syrup (HFCS) is a transparent sweet liquid and free of off-flavour that has a broad application compared to other sweeteners. This sweetener has received a high interest from consumers due to its unique advantages compared to other sweeteners. HFCS exerts many properties such as sweetening, increasing the osmotic pressure, water holding, lowering the freezing point and enhancing the shelf life, when added to the food products. Therefore, HFCS is considered as a natural sweetener with contribution in enhancing product shelf life. Corn syrups contain various proportions of fructose and glucose and are usually introduced based on the fructose content. There are two most common types of fructose syrups which contain 42 and 55 % of fructose on dry basis. Depending on the fructose content, different properties can be observed. Based on the specific technological properties, the proportion of fructose and glucose can be altered to meet the target application.

HFCS 42

Properties of corn syrup containing 42 % fructose on dry basis	
Fructose (% on dry basis)	42
Dry solids (%)	70.5-71.5
Brix (at 20°C)	68.2-69.2
pH	3.3-4.5
Aroma	Aromaless
Color	Transparent and colorless

HFCS 55

Properties of corn syrup containing 55 % fructose on dry basis	
Fructose (% on dry basis)	55
Dry solids (%)	76.5-77.5
Brix (at 20°C)	75-76
pH	3.3-4.5
Aroma	Aromaless
Color	Transparent and colorless

Applications of fructose syrup in food industry

1. Drinks

Fructose syrup is commonly used as a sweetening agent in the formulation of drinks (carbonated beverages, fruit juices, energy drinks, beers and etc.) in many countries. Application of fructose syrups has the following advantages:

- High purity and high stability of color compared to other sugars;
- Intensifying fruit flavor;
- Providing sweetness and proper flow characteristic in drinks and nectars;
- Low initial microbial load;
- Lower cost and ease of use, which lead to the saving in time, energy and workforce;

2. Processed fruits (jams and compotes);

Fructose and glucose are natural sugars that are found in fruits. Corn syrups can be used in different products containing fruits such as jams and compotes and have the following technological advantages:

- Reducing water activity and increasing shelf life of jams;
- Balancing the osmotic pressure in drinks containing fruit pieces;
- Prevention of crystallization in jams;
- Intensifying the fruit flavor in fruit containing products;
- Improving flow characteristic in compotes;

3. Bakery products

Glucose and fructose are fermentable sugars that are consumed by yeast in the bakery industry. Moreover, these reducing sugars participate in Maillard reaction and contribute to the formation of brown color during baking. Application of these syrups in the bakery products has the following advantages:

- Increasing of fermentation rate.
- Increasing the rate of Maillard reaction.
- Retaining the moisture and freshness.
- Increasing of osmotic pressure and preventing microbial contamination.
- Improving bread's texture.
- Improving the color of bakery products.

4. Ice cream and dairy products

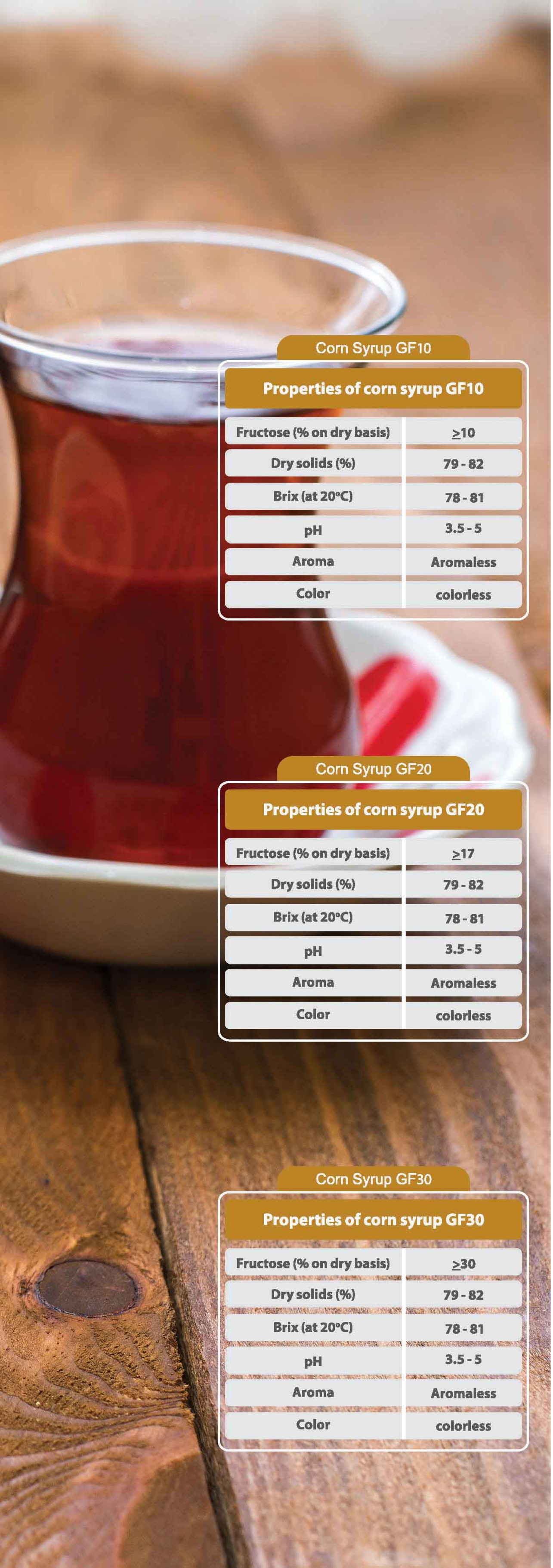
In addition to giving sweetness, fructose syrups contribute in other functional properties such as control of crystallization and exerting fruit flavor in dairy products. Application of these syrups in dairy products has the following advantages:

- Reduction of freezing point and giving a smooth and scoopable texture.
- Preventing formation of large ice crystal, lactose crystallization, and sandy texture in ice cream.
- Direct application of syrups in final products due to being sterilized.
- More convenient application of syrups in flavored creams and dairy desserts.
- Sweetening agent in flavored milks.
- Generating mild flavor in dairy dessert.

5. Sauces and dressings

Sweeteners play an important role in the flavor, texture and aroma of final products. Being soluble, fructose syrups can be added directly in the final stage of formulation and has the following technological properties:

- Retaining the flavor of sauces (do not have the covering effect on the flavor);
- Improving the viscosity and increasing the brightness;
- Convenient usage due to the liquid nature.



Corn Syrup GF10

Properties of corn syrup GF10	
Fructose (% on dry basis)	≥10
Dry solids (%)	79 - 82
Brix (at 20°C)	78 - 81
pH	3.5 - 5
Aroma	Aromaless
Color	colorless

Corn Syrup GF20

Properties of corn syrup GF20	
Fructose (% on dry basis)	≥17
Dry solids (%)	79 - 82
Brix (at 20°C)	78 - 81
pH	3.5 - 5
Aroma	Aromaless
Color	colorless

Corn Syrup GF30

Properties of corn syrup GF30	
Fructose (% on dry basis)	≥30
Dry solids (%)	79 - 82
Brix (at 20°C)	78 - 81
pH	3.5 - 5
Aroma	Aromaless
Color	colorless

Corn Syrup GF10

This syrup has the lowest amount of fructose and therefore the lowest sweetness and the highest consistency compared to other syrups. Sometimes, this sweetener is called Baklava syrup.

Applications of GF10 corn syrup are as follows:
- Improving Baklava (Turkish and Arabic) flavor;
- Application in Halvah formulation;
- Application in fillings and tarts formulation.

Corn Syrup GF20

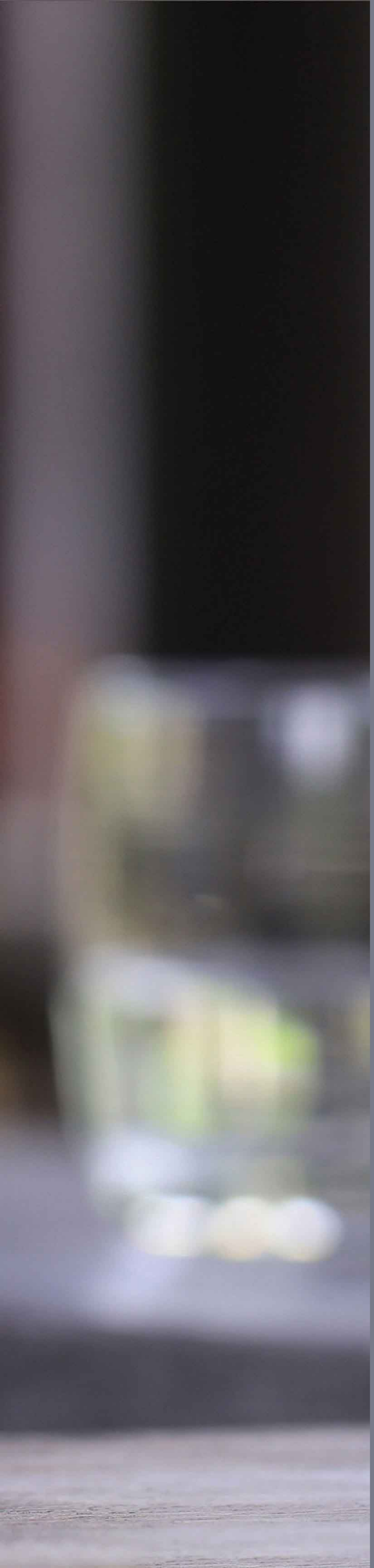
This syrup contains glucose and fructose monosaccharaides and maltose disaccharide which comprise the 50% of the dry solids of this syrup.

Applications of corn syrup GF20 are as follows:
- Exerting a mild sweetness and high brightness in jams and jellies.
- Exerting a mild sweetness in Halvah, Nouka and Gaz (traditional Iranian sweets).
- Prevention of grittiness in ice cream.

Corn Syrup GF30

This product has a mild and pleasant sweetness. Due to its specific characteristics, it is used in jam industry to produce a product with a clear and bright appearance with an improved flavor.

This product has the following applications:
- In the formulation of jams, marmalade and compotes with improved organoleptic properties.
- Biscuit and low-sweet bread making.



Liquid glucose

Liquid glucose is a product of starch hydrolysis. Based on the degree of hydrolysis (DE), the properties of liquid glucose are determined. The hydrolysis of starch for production of glucose syrup is carried out by acidic or enzymatic methods. The enzymatic production of this product has the following advantages:

- A transparent and colorless product.
- Higher purity.
- Flavorless and odorless.
- Longer self-life.
- Safe and homogenous product.
- Free of microbial contamination.
- No chemicals (acids) are used in its production.
- Free of contaminants.

Functional properties of glucose syrup are as follows:

- Developing a uniform texture.
- Exerting a mild sweetness.
- Increasing the brightness of the product.
- Extending of shelf life.
- Increasing of product's brix.
- Lower moisture intake.
- Developing a golden crust in bakery products.

Glucose Syrup DE38

Properties of Glucose Syrup DE 38	
Dextrose Equivalent	36-39
Dry Solids (%)	81-84
Brix (at 20°C)	80-83
pH	4.5 - 5.5

Glucose Syrup DE42

Properties of Glucose Syrup DE42	
Dextrose Equivalent	40-44
Dry Solids (%)	81-84
Brix (at 20°C)	80-83
pH	4.5 - 5.5

Glucose Syrup DE60

Properties of Glucose Syrup DE 60	
Dextrose Equivalent	59-63
Dry Solids (%)	81-84
Brix (at 20°C)	80-83
pH	4.5 - 5.5

Glucose Syrup DE 95

Properties of Glucose Syrup DE 95	
Dextrose Equivalent	93-95
Dry Solids (%)	65
Brix (at 20°C)	62-64
pH	3 - 5

Glucose Syrup DE 38

Applications of glucose syrup DE38 are as follows:

• Jelly candies: prevention of sugar crystallization and improving of chewability.

• Chewing gum: improving of chewability and preventing of crushing and adhesion to the teeth;

• Toffee and caramels: controlling product's moisture, increasing the shelf-life and improving of chewability;

• Hard candies: increasing of transparency and preventing the adhesion of candy to skin;

• Coffee mix (creamers) and fat concentrate in coffee: facilitating of spray drying process and preventing the adhesion of material to the tower of spray dryer; improving the mouth-feel and adjusting the sweetness.

Glucose Syrup DE 42

Applications of glucose syrup DE42 are as follows:

• Cake and cookie fillings: sweetening and texturizing agent.

• Ice cream and dairy desserts: creating a desirable texture; improving of mouthfeel; exerting a mild sweetness.

• Gaz and Halvah: creating a desirable texture and mild sweetness.

• Cake and cookies: texturizing agent and exerting a mild sweetness in combination with sucrose or fructose syrup.

• Jams and fruit concentrate: increasing the consistency and developing a desirable texture; controlling of crystallization; increasing of shelf life.

Glucose Syrup DE 60

Specific applications of glucose syrup DE60 are as follows:

• Fruit juices with sour and astringent taste: developing a mild sweetness

• Pulpy fruit juices: stabilizing agent; improving of mouthfeel.

• Bakery products: developing a mild sweetness and a bright brownness.

Glucose Syrup DE 95 (dextrose)

This syrup has the highest sweetness and the lowest viscosity in comparison with other glucose syrups. Glucose syrup DE95 which is also called liquid dextrose is a favourable product in industrial microbiology, especially in the production of fermentation medium.
Specific applications of glucose syrup DE95 are as follows:
Production of alcohol, vinegar, citric acid, penicillin, fermented products, crystalline dextrose and bakery yeast.
Zar fructose Co. has one of the most advanced production technology, therefore, can produce various syrups with a wide range of DE and brix according to the consumer demand.

Changes in the properties of glucose syrups as a result of changes in DE

Property	By decreasing DE	By increasing DE
Filler	▼	
Browning		▲
Adhesiveness	▼	
Stabilizing of color		▲
Emulsion stabilizer	▼	
Fermentability		▲
Flavor enhancement		▲
Flavor carrier		▲
Foam stabilizer	▼	
Freezing point depression		▲
Boiling point elevation		▲
Moisture absorption	▼	
Osmotic pressure		▲
Preservation		▲
Development of large crystals		▲
Preventing sucrose crystallization		▲
Sweetening		▲
Water Holding Capacity	▼	
Consistency	▼	
Viscosity	▼	

▲ Increase in the property

Applications of corn syrups in pharmaceutical industries

In pharmaceutical industries various sugars with different functions are used. Sucrose is a common sweetener in pharmaceutical industries, but due to the risk of crystallization in products, its usage has been gradually replaced by corn syrups. Pure glucose syrup (dextrose) and fructose syrup have many applications in pharmaceutical industries due to their unique properties:

Intravenous fluids

- Application of pure glucose (dextrose) in the production of sugar solution.
- Application in medical syrups as a sucrose replacer in order to eliminate the risk of sucrose crystallization, increasing the consistency and shelf life.
- Application in the coating of pills.
- As a carbohydrate source in the fermentation process of antibiotics production.

Properties of crystalline dextrose (application in pharmaceutical industry)	
Dextrose Equivalent	≥ 90%
Conductivity (micro Siemens)	≤20
Moisture	≤0.5%
Acidity	≤0.3%

Maltose syrup

Maltose is a disaccharide formed from glycosidic linkage of two glucose units. This molecule is produced by special enzymes in the process of liquid sugar production and due to its unique properties, it has received special applications in various industries. High maltose corn syrup is responsible for the improved aroma, flavor and texture and inhibits the crystallization and color formation in various food products. Due to the lower glucose concentration, this product contributes less in Maillard reaction at higher temperatures, which is an advantage in its application in the formulation of candies. This syrup contains a high concentration of fermentable sugars, which makes it a suitable ingredient in the formulation of bakery products.

Applications of maltose syrup are as follows:

- Increasing the lightness and creamy texture of hard candies.
- Improving the texture and chewability of Nogha.
- Improving the texture of bakery products such as biscuits and cookies.
- Improving aroma, flavor and texture in fermented products.

Corn Maltose Syrup

Properties of Maltose Syrup	
Dry solids (%)	80.4 - 81.6
Moisture(%)	18.4 - 19.6
Maltose (% on dry basis)	50
pH	4.5 - 5.5
Aroma	Aromaless
Color	colorless

Maltodextrin

Maltodextrin is a mixture of poly and oligosaccharides that has a DE of lower than 20. This product is used in a wide range of food products due to its unique properties such as solubility in cold water, low viscosity and sweetness (in solution), and texturizing agent.

Industrial applications of maltodextrin

I. **Dairy industry**

• In low fat cheeses produced by ultrafiltration: substituting 15 to 50% of fat, retaining water and preventing the weight loss in salty cheeses.
• Processed cheeses: stabilizing, texturizing, fat substitute, and increasing the spreadability.
• Low fat yogurt: lowering the fat content and preventing the syneresis phenomenon.
• Confectionery cream and Ice cream: fat substitute, filler, and stabilizing agent.

II. Candies, fondants and chocolate

• lower caramelization.
• Increasing the transparency and improving the texture.
• Reducing the viscosity and capable of forming instant gel.
• Production of transparent and appetizing films for covering of candies.
• Reduction of sugar content (up to 30% in chocolate)
• Improving the rheological properties of chocolate

III. Non alcoholic drinks

• Improved mouthfeel.
• Increased transparency.
• Flavor enhancer.

IV. Bakery products

• Retaining the moisture and lowering the rate of staling.
• Increasing the volume and improving the texture.

V. Canned foods

• Increasing the viscosity and consistency.
• Mouthfeel improvement.
• Reduction in sweetness.

VI. Infant formula

- Prevention of caking and crystallization.
- Improving the texture and increasing the solubility.
- Better digestion and mild sweetness.

VII. Fat substitute

- Production of low calorie products.
- Substitution of fat by maltodextrin gel.
- Reducing the release of volatile compounds in low fat meat products as a fat substitute.

VIII. Athlete food

- Energy drinks;
- Recovery drinks;
- Powdered supplement;

IX. Production of fruit powders

As a carrier agent in production process of fruit powder and inhibiting the caking phenomena in the final product.

X. Pharmaceutical applications of maltodextrin

Maltodextrin has various applications in pharmaceutical industry due to its specific properties such as good solubility in water, desirable mouthfeel, gel forming property, and emulsion stabilizer. These applications are as follows:

- As a diluent in tablets and coating agent for microencapsulation of various materials such as vitamins.
- Production of edible films.
- Facilitating the compression of drugs.

Properties of Maltodextrin	Powdered Maltodextrin		Liquid Maltodextrin	
Parameter (%)	Min.	MAx.	Min.	MAx.
Dextrose Equivlent	–	20	–	20
Protein	–	0.5	–	0.5
Dry Solids	90	–	50	–

Corn Starch

Starch is a polysaccharide of glucose monomers which have joined together by glycosidic bonds. This polysaccharide is produced by plants in the form of granules and is served as their energy source. Corn, wheat and potato have a large proportion of starch in their structure. About 70% (dry basis) of dent corn composition is starch. Starch has many applications in different industries such as food, paper, textile, fermentation, drilling and many others. Powdered starch is produced by the partial dehydration of starch slurry by mechanical means such as centrifugation and vacuum filter followed by the final drying by hot air. Native starch has gained a special attention in industrial applications due to its properties such as gel forming ability, viscosity enhancer, texturizing, and moisture adjustment. In order to improve the properties of starch and increase its applications, some physical or chemical modifications are performed on its structure. These products are called modified starches. Oxidized, cationic, acidic, phosphated and pregelatinized starches are as examples.

Applications of industrial starch

Owing to its special properties, starch can be used in industries such as adhesives, paper, corrugated board, textile and etc.

Properties of industrial starch

Moisture	<13%
Density (kg/m^3)	625-675

Zar Grain Refinery, Hashtgerd-Iran
Tel:+9826 4321 2000
www.zarfructose.com
info@zarfructose.com