

All made of sugar – Glycosides in skin care products

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What does a lump of sugar have in common with hyaluronic acid, algae extract or the so-called AGE deposits in atrophic skin? They all belong to the family of glycosides - a substance class that can be found in a whole variety of cosmetic preparations.

It is worth taking a closer look at glycosides. They not only are components of the chitinous exoskeleton of insects or enhance the flavour of food - they basically belong to the most common substances in animated nature. They also play a decisive role in cosmetics. Lump sugar consists of saccharose (or sucrose) which is a compound of fructose (fruit sugar) and glucose (dextrose or grape sugar). The combination of two different sugars is called glycoside, or in cases where glucose is concerned, glucoside.

In our natural environment, oligosaccharides (combinations of specific sugars among each other as for instance sucrose) and polysaccharides (many sugar molecules stringing together) perform various tasks:

- The water soluble oligosaccharides serve for the energy transport in cells: They are stored and transferred into starch (plants) or glycogen (animals, humans) and again mobilized from storage when needed.
- Glycosides such as cellulose form the plant cell walls and fibres while insects and shellfish protect themselves with chitin.
- Hyaluronic acid is a mucopolysaccharide and the glycosidic main component of the extracellular matrix; it is responsible for the pressure resistance of the connective tissue.
- Mucigenous glycosides ("gum") such as xanthan formed by xanthomonas bacteria, guar (guar or cluster bean), pectins (fruits), gum Arabic (Arabian gum tree), acemannan (aloe vera), galactoarabinan (North American larch tree) and alginates from algae extracts are further examples for the inventiveness of nature.

Within the scope of skin care, saccharides are widely used as filming agents, consistency agents, humectants and wrinkle smoothers. Also applied are partial hydrolysates (cleavage

products) and semi-synthetic derivatives of starch, cellulose, chitin and alginates such as for instance hydroxypropyl starch, dextrans, hydroxyethyl cellulose, carboxymethyl cellulose, methyl cellulose, chitosan or alginic acid hydrolysates with similar functions. CM-glucan is a carboxymethylated polysaccharide of yeast with photoprotective features. Emulsion stabilizers form when starch is esterified with phosphoric acid. Chitosan is a partial hydrolysate of chitin and used as a hair conditioner, among others.

Detergent alkylpolyglycosides (APG) which are found in mild cleansing products belong to a further variety of glycosides. In these non-ionic sugar surfactants, long-chained alcohols are combined with sugar molecules. Hence, we generally speak of glycosides, if a sugar ("glycon") is combined with an alcohol (sugars are polyvalent alcohols), phenol or amine. These components are called "aglycons". Compounds of sulphur (thioglycosides) and selenium (selenoglycosides) also belong to this group. And to formulate it:



Such natural substances are extremely versatile. They are enzymatically formed through glycosyltransferases and cleaved again through glycosidases, if needed. Their importance for living organisms consists in the fact that a lot of difficultly soluble natural substances become water soluble through glycosylation. In the metabolism of organisms they can only be transported in the form of a glycoside. By the way, our kidneys dispose of water-insoluble substances such as steroids, pharmaceutical metabolites and toxic substances through glycosidic bond to glucuronic acid (saccharic acid). This process is called glucuronization. By analogy, the yellow bile pigment bilirubin is excreted via intestines after glucuronization.

Various natural substances

In aqueous plant extracts a lot of cosmetic active agents are contained in the form of a glycoside. Here are some examples:

- Arbutin does not only consist of a water soluble compound (glycon: glucose) but also contains the stabilized form of an oxidation sensitive substance (aglycon: hydroquinone). Arbutin is administered in the case of hyperpigmentations.
- Anthocyanins are glycosidic vegetable dyes with an aglycon in the form of flavon-like, positively charged polyphenols such as cyanidin (E163b). Their colour depends on the pH level. They are used as food dyes (E 163x).
- Flavonoids such as quercetin (glycoside: rutin) and hesperidin form water soluble glycosides with antioxidative, antimicrobial and partly vessel-stabilizing effects (rutin).
- Isoflavones ("phytohormones") have local estrogenic effects. The most significant isoflavones are daidzein (glycoside: daidzin) and genistein (glycoside: genistin); they occur in soy and red clover.
- In the case of natural glycolipids, mono or oligosaccharides form glycosidic bonds (sphingoglycolipids, cerebroside) with diglycerides of fatty acids (glyceroglycolipids) or ceramides. They are components of cell membranes. From the cosmetic point of view, glycolipids are valuable and rapidly biodegradable biosurfactants for cleansing preparations, similar to alkylpolyglycosides. An obstacle is the elaborate manufacturing process though.
- Salicin is a glucoside of willow bark extract. Salicin is formed from glucose and salicyl alcohol and has antimicrobial effects similar to salicylic acid. In the body salicin is metabolized into salicylic acid.
- Saponins are glycosides of steroids and triterpens. Glycyrrhizin of liquorice as a glycoside of glycyrrhetic acid belongs to this group. The saponin ruscin occurs in butcher's broom extract, steroidal saponins are also found in kigelia extracts (sausage tree). The above-mentioned but also further saponins stabilize the superficial capillary blood vessels and tighten the surrounding connective tissue similar to aescin (mixture of different saponins of chestnut). The extracts are used in

eye preparations as well as in products for the rosacea-prone skin, couperosis, edema, and for the care of the décolleté. Saponins also occur in the tightening horsetail extract.

By the way: Digitalisglycosides from foxgloves which are an effective cardiac also belong to the glycosides. The bitter and tangy principles of mustard, of horse radish or also wasabi belong to the mustard oil glycosides.

Glycoproteins & Co

The following substances belong to the glycosides with amines:

- Nucleosides such as adenosine, guanosine, cytidine and uridine. The sugar component here is ribose. Desoxy compounds result from desoxyribose.
- Nucleotides are the mono, di and triphosphates of nucleosides such as for instance AMP, ADP and ATP (adenosinmono-, -di- respectively -triphosphate) as well as analogous desoxy compounds).
- Nucleic acids are composed of nucleotides. DNA (deoxyribonucleic acid) contains nucleotides with desoxyribose whereas RNA (ribonucleic acid) is formed with ribose.
- Glycoproteins are enzymatically formed by proteins and sugars. The membrane proteins of cells, immunoglobulines (responsible for the immune response), interferons as well as the mucigenous mucins (occurring in mouth, stomach, intestines, nose or bronchial tubes) belong to this group. Glycolipoproteins are responsible for the different blood types.

Nucleosides, nucleotides and animal extracts with glycoproteins occasionally are used for skin care purposes. From today's point of view the benefits rather consist in sales promotion aspects though. Ribose nucleotides serve as flavour enhancers in food (E 6xx). Inosine monophosphate (E 630) for instance has a meat-like flavour.

Glycation

The term glycation refers to a non-enzymatic reaction. During this uncontrolled reaction of the body, fructose, galactose or glucose and proteins will not only form glycosides but also condensation products analogous to the Maillard reaction. The products can also be coloured (melanoidins). The reaction products

whose chemical structure has not yet been defined are summarized with the term **AGE** which means **Advanced Glycation Endproducts**. They also gradually accumulate in the skin and influence the complexion. **AGE** are formed through

- skin aging
- excess supply of glucose in our nutrition

- hyperglycaemia
- diabetes mellitus
- kidney failure

Their influence on the formation of age marks still is being discussed. As you can see, making yourself familiar with glycosides reveals a whole variety of different interrelations.

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