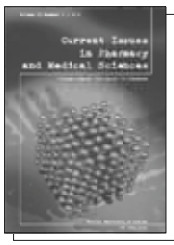

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Artificial tears and saliva substitutes

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ABSTRACTS

An adequate amount of water in cells and tissues is a prerequisite for the proper functioning of every organism, and every organ within that organism. Its deficiency can cause serious clinical symptoms and subjective troublesome ailments among patients. The authors present in this study, the most commonly used preparations in patients exhibiting dry eye and / or dry mouth.

Keywords: artificial tears, artificial saliva, saliva substitutes

An adequate amount of water in cells and tissues is a prerequisite for the proper functioning of all organisms, and every organ within these organisms. Its deficiency can cause serious clinical symptoms and subjective troublesome ailments. This applies particularly to the eyes, mouth and nose [4, 15].

An adequate degree of moisture for the front surface of the eye is provided by a three-layer tear film. This consists of a layer of water (responsible for moisturizing), a mucous layer (providing adhesion) and a fatty "sliding" layer (that protects tear film against excessive evaporation). A deficiency of any of the layers may cause the so-called "dry eye syndrome". This is manifested by excessive exfoliation of the epithelium of the cornea and conjunctiva, with associated features of inflammation and considerable discomfort – blurred vision, burning, itching and the feeling that there is some grit under the eyelids. These symptoms are worsen at night, while working at a computer, or when in a polluted, smoky or air-conditioned room. Therefore, people with the ailments listed above need to use emollients in the form of gel or eye drops [2, 7].

The proper degree of moisture within the mouth is provided by the saliva, which is necessary for maintaining the integrity of its tissues. Properly functioning salivary glands secrete a 0.5–1.0 liters of saliva a day, of which 2–10% is excreted in the night. Eating stimulates the activity of the salivary glands, inducing these to secrete saliva at 10ml per minute. When sleeping, the speed is reduced to 0.25 ml per minute. Saliva is composed of 99% water, while the remaining 1% is organic components (proteins, immunoglobulins, albumin, glycoproteins, enzymes, nitrogen compounds: urea, uric acid, amino acids, creatinine, carbohydrates, lipids: cholesterol, lecithin, phospholipids, free fatty acids, hormones) and inorganic elements (cations: calcium, magnesium, sodium, potassium, iron, copper, anions: phosphate, carbohydrate, fluorine, chlorine, iodine, sulfur, rhodanide). Saliva plays many important functions inside the mouth. These can be divided into three groups: a) defensive functions: antibacterial (lysozyme, lactoferrin, mucin, citostatins, fibronectin, proline-rich protein, IgA, IgG, IgM, peroxidase, histatins), moisturizing (water), buffering (bicarbonate and phosphate ions), dilution (water), remineralization (proline-rich anionic proteins, calcium, phosphates, staterin), integrity of the mucosa (mucin, water, electrolytes), lubricational (water-rich glycoprotein, proline, mucin); b) speech-related functions (water, mucin); c) functions associated with the intake of food: the sense of taste (water), the preparation of a bite (water, mucin), digestion (lipase, amylase, protezasis, mucin, ribonuclease, water) [6, 10].

The most common causes of occurrence of dry mouth are the persistent taking of painkillers, diuretics, antidepressants, and antihistamines; the side effect of certain diseases such as diabetes, anemia, hypertension, AIDS, Sjogren's syndrome, hyperthyroidism, mumps and dehydration; as well as certain medical treatments, among these, radiotherapy of head and neck cancers. In patients with dry mouth, there are both objective and subjective problems. Among the more common objective ailments are the rapid development of dental caries, atypical dental caries, increased deposition of plaque, periodontal inflammation, ringworm of the mouth, the abrasion of the teeth, inflammation of oral mucosa, the occurrence of cracks and ulcers, dry mouth, intolerance, and non-adhesion of prostheses, severe bacterial infections and viral infections of the lips and salivary glands, nutritional deficiencies, insomnia and depression. In regard to the more common subjective ailments, patients re-

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port increased thirst, difficulty in swallowing and chewing, slurred speech, dry, burning tongue, a common desire to humidify the mouth, a roughened surface of teeth, bad breath, a feeling of considerable density, and an increase in the viscosity and viscidity of the saliva [5,14]. The aim of this study is, therefore, to present the most commonly used preparations in patients to mitigate the conditions of dry eye and / or dry mouth.

Table 1 shows the most commonly used preparations in this treatment. Among these are the so-called artificial tears (individual substances being detailed, the names of each provided and form of the preparation revealed).

Table 1. The most commonly used artificial tears

Main substance	Preparation name	Manufacturer	Form	Remaining elements
Polyvinyl alcohol	Lacrimal	POLFA WARSZAWA	drops	disodium phosphate dodecahydrate, sodium dihydrogen phosphate monohydrate, sodium chloride, benzalkonium chloride, purified water
Carboxymethyl cellulose sodium	Optive	ALLERGAN	drops	purite, glycerine
	Refresh	ALLERGAN	drops	purite
Povidone (polyvinyl-pyrrolidone)	PVP COMOD	URSAPHARM	drops	sorbitol, sodium hydrogen phosphate
	Visine Dry Eyes	PFIZER	drops	glicerol, triglicerides
	Oculotect	NOVARTIS PHARMA	drops	benzalkonium chloride, boric acid, sodium chloride, potassium chloride, sodium lactate, calcium chloride, magnesium chloride, sodium hydroxide, water for injections
Carbomer	Oftagel	SANTEN	drops	
	Liposic	DR MANN PHARMA		
	Visine Noc	PFIZER	drops	povidone
Hydroxypropyl methylcellulose (hypromellose)	Tears Naturale	ALCON	drops	dextrane
	Artelac	DR MANN PHARMA	drops	
Hydroxypropyl cellulose	Gen Teal	NOVARTIS	drops	sodium perborate
	Gen Teal Gel	NOVARTIS	gel	
Sodium hyaluronate	Gen Teal HA	NOVARTIS	drops	sodium chloride, sodium phosphate, sodium perborate, stabilized with phosphonic acid
	Benein	SANMED	drops	poliheksanid, disodium versenate, isotonic phosphate buffer, purified water
	Hylo-Lasop	URSAPHARM	drops	
	Biolan	PHARM SUPPLY	drops	sodium chloride, alkaline sodium phosphate, dibasic sodium phosphate, purified water
	Hyabak	THEA	drops	
	Hylo COMOD	URSAPHARM	drops	citrate buffer, sorbitol, water
	Hylo-Gel	URSAPHARM	drops	
	Vismed	TRB CHEMEDICA	drops	sodium chloride, potassium chloride, sodium hydrogen phosphate, sodium citrate, magnesium chloride, calcium chloride, water for injection
	Hialeye	BLAU PHARMA	drops	
	Oxyal	SANTEN	drops	
	Starazolin Hydrobalance	POLPHARMA	drops	
Polyacrylic acid	Oftipan	JELFA	drops	cetrimide, crystallizing liquid sorbitol, disodium edetate, sodium hydroxide, purified water
	Vidisic Gel	DR MANN PHARMA	gel	
	Vidisic	DR MANN PHARMA	drops	cetrimide, sodium hydroxide, sorbitol, water for injections
Polyethylene glycol, propylene glycol	Systane	ALCON	drops	propylene glycol, hydroxypropyl guar gum, sorbitol, aminomethyl propanol, boric acid, potassium chloride and sodium chloride

The primary component of artificial tears is water. However, to keep it on the surface of the eye, thickening agents (polymers) are necessary, these forming a sort of scaffolding. Depending on the polymer and its physicochemical properties, the time of water release, and thus the time of the droplet activity is different. Polyvinyl alcohols are characterized by the shortest activity; preparations containing hydroxypropyl methylcellulose have medium-time of activity; while the longest time of water release is by way of the use of hyaluronic acid. What is more, to extend the time of activity of artificial tears, some companies also offer preparations with increased viscosity – gels [8].

Other components of artificial tears are substances that improve the tolerance of the drops, ensuring proper pH, so that they could as accurately as possible, replenish the tear film composition. Unfortunately, in order to ensure that the drops could be used for a long time after opening, it is necessary to add preservatives to them. These cause side effects, and consequently, may increase the symptoms. Therefore, pharmaceutical companies have in their offer preparations without preservatives. These come in a specially constructed mini- or multi-dose packaging. Such drops are particularly indicated for people who must use the therapy for a long time, for several times a day, in the young, and for those wearing contact lenses [9].

Table 2 shows the most commonly used preparations that are called 'artificial saliva'. In addition, details are provided of individual substances, the names of the preparation and their form.

Table 2. The most commonly used preparations of artificial saliva

Name	Manufacturer	Form	Composition
Xerostom	Biocosmetics Laboratories	spray, capsules, chewing gum, gel, mouthwash, lozenges, toothpaste	betaine, olive oil, calcium, fluoride, xylitol, vitamin E, allantoin, vitamin B5, potassium
BioXtra	Sunstar Americas Inc. Butler GUM	spray, gel, lozenges, chewing gum, mouthwash, toothpaste,	lactoperoxidase, lysozyme, lactoferrin, immunoglobulins, xylitol, fluoride, aloe vera, water, glucose oxidase. Other ingredients include whey extract
Dry Mouth Gel	GC America Inc.	gel	water, polyglycerol, sodium carboxymethylcellulose, carrageenan, sodium citrate, ethyl p-hydroxybenzoate,aroma
Mucinox/Mouth Kote	Parnell Pharmaceuticals	aerosol	water, sorbitol, xylitol, an extract of Yerba Santa, natural lemon flavor, ascorbic acid, sodium benzoate, sodium hydroxide
Salivarex	Pater Laboratorium	mouthwash	water, glycerol, xylitol, cellulose gum, aloe, potassium chloride, sodium chloride, magnesium chloride, calcium chloride, sodium hydrogen phosphate, sodium phosphate, sodium fluoride, sodium saccharin, flavor, 2-bromo-2-nitropropano-1 ,3-diol, sodium benzoate
Profylin	Prophylactor AB, Switzerland In Poland: Nycomed Polska Sp. z o.o.	gel, tablets	xylitol, sorbitol, phosphates, magnesium stearate, sodium bicarbonate, silicon dioxide, peppermint flavor, carboxymethylcellulose, calcium chloride, malic acid
Biotene Oralbalance	GlaxoSmithKline Pharmaceuticals	gel, toothpaste, mouthwash, spray, chewing gum, moisturizing liquid	water, xylitol, sorbitol, glucose, glycerin, hydroxyethylcellulose, butylene glycol, polyacrylic acid, sodium poliakrylat, sorbic acid

Glandosane	Fresenius Kabi Ltd	spray	carboxymethyl cellulose, sorbitol, sodium chloride, potassium chloride, calcium chloride, magnesium chloride, potassium hydrogen phosphate, peppermint flavor, carbon dioxide
Xeros	Dentaid	toothpaste, mouthwash, spray, gel, tablets, chewing gum	betaine, xylitol, sodium fluoride, allantoin,
Dry Mouth Relief	Colgate Oral Pharmaceutical, Inc.	mouthwash	sodium fluoride, water, glycerin, propylene glycol, sorbitol, poloxamer 407, monosodium phosphate, sodium benzoate, betaine, flavor, sodium hydrogen phosphate, xanthan gum, carboxymethylcellulose, carbomer, cetylpiridines chloride, sodium saccharin,
SalivaSure	Scandinavian Formulas Inc.	lozenges	sorbitol, polyethylene glycol, malic acid, hydrogenated cottonseed oil, sodium citrate, citric acid, dicalcium phosphate, silicon dioxide, carboxy-methylcellulose

The use of saliva substitutes should take place after firstly performing a diagnostic test, then additional tests so as to find the causes of dry mouth (real or alleged). True dry mouth or Xerostomia is manifested by a real decline in the amount of saliva secreted, but the alleged Xerostomia is only a subjective feeling of dry mouth, and may be caused by vegetative neurosis [1,3].

The most important task of these saliva substitutes is, by having the similar physical and chemical properties of natural human saliva, completely replacing all its functions. Unfortunately, so far no preparation has been found to meet all the characteristics of saliva. However, the preparations moisturizing mucosa for dryness of the mouth have particular moisturizing substances which sooth irritation, give a pleasant and fresh taste and aroma and reduce the number of caries bacteria (xylitol, sorbitol).

What is more, the composition of the preparations also includes compounds dependent on the form of the preparation (silicone dioxide – a tablet or capsule shell, carbon dioxide – spray, carboxymethylcellulose, carbomer – thickener and stabilizer). Moreover, these preparations commonly include: Glycerin – a substance for moisturizing, softening, protecting the mucosa from excessive water loss; Xylitol - prevents the accumulation of plaque on the tooth surface, controls the pH level; Carrageenan – is a compound derived from *Chondrus crispus* seaweed that possesses swelling, coating, protective properties; Betaine – is a natural derivative of the amino acid glycine, effectively reduces the irritation caused by surfactants, reduces the surface tension, has a preventive action on the mucous membrane; and Allantoin – has anti-inflammatory properties, soothes irritation, moisturizes, promotes healing, and provides a protective coating upon soft tissue.

Other ingredients include: *Aloe Vera* – has 160 active ingredients such as vitamins A, E, C and E, enzymes, proteins, biostimine, sugars, trace elements, has anti-inflammatory, antibacterial, soothing, moisturizing, regenerating, astringent and moisturizing properties, it also protects against solar radiation; Glucose oxidase – a substance that can be found in, among other items, honey, and has antibacterial properties; Olive oil – protects against infections, and prevents bad breath (halitosis); and *Yerba Santa* – a flavonoid having a moisturizing, expectorant, antispasmodic, diaphoretic, antipyretic and tonic effects, is with anti-asthmatic and anti-exudative properties, and has the ability to strengthen and seal the blood vessels [11,12,13].

The treatment of any disease should be aimed at eliminating the causal factors. However, in regard to dry mouth or dry eye syndrome, this is possible in only few patients to apply symptomatic treatment. While the above formulations – saliva substitutes and artificial tears effectively improve the quality of life of the patient, this is not sufficient. Patients with dry mouth or eye dryness should be encouraged to participate actively in the treatment of these ailments, both through the use of appropriate substitutes of tears or saliva, as well as through appropriate training habits conducive to reducing the risk of developing symptoms and pathological changes within their mouths or eyes.

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