Xylitol

effective in preventing and even reversing tooth decay

By Dr Jonathan V. Wright, MD © 2020

With good dental hygiene and restricted consumption of sugary foods (especially sucrose), it's easy to reduce the occurrence of cavities (also known by their medical/dental name, *caries*). Still, dental caries remain quite common. But despite research reported[1] from the Harvard School of Public Health in 2012 and a much more recent research publication[2] in the *Journal of the American Medical Association* publication *JAMA Pediatrics*, both of which told us that fluoride significantly lowers children's IQ, and despite all the research summarised proving that xylitol prevents and even reverses tooth decay, our tax-funded National Institutes of Health persists in telling us[3]:

"Helpful Tips: Here are some things you can do to prevent tooth decay: Use fluoride, a mineral that can prevent tooth decay from progressing, and even reverse, or stop, early tooth decay. You can get fluoride by brushing with fluoride toothpaste, drinking tap water with fluoride, [and] using fluoride mouth rinse".

There's not even mention on this National Institutes of "Health" website[3] of the superior-to-fluoride effects against tooth decay of the natural sugar xylitol, despite all of the research proof summarised below!

We all know that tooth decay is a bacterial disease. Without the bacteria *Streptococcus mutans* (*S. mutans*) in our mouths, sucrose, high fructose corn syrup, and many other sweeteners would go on to increase the risk of type 2 ("maturity-onset") diabetes and other diseases, but tooth decay wouldn't be much of a problem. Restricting consumption of certain carbohydrates—

especially sucrose and high fructose corn syrup—hobbles *S. mutans* bacteria by depriving them of their primary source of fuel.

Some readers may already know that xylitol, a 100 per cent natural sugar, is research-proven to be safe and effective in preventing and even reversing tooth decay. Yes, just in case you didn't know, a sugar that prevents and reverses tooth decay! Xylitol is derived from certain fruits, vegetables, berries, and nutshells. Even though xylitol is just as sweet as sucrose, regular use of xylitol-containing products—such as gums, candies, lozenges, toothpastes, and others—can halt tooth decay in its tracks and may even promote the healing of cavities that are already underway. Even more remarkably, if young children begin using xylitol-sweetened gums, candies, and toothpastes during the year before they start to lose their "baby teeth", as long as they take reasonable care of their teeth, they may be protected against caries for the rest of their lives.

(Image: nz.iherb.com)

Xylitol works so well because it interferes with the bacteria that cause tooth decay, halting their growth and preventing them from sticking to tooth surfaces. It is ideal for children because xylitol-sweetened foods taste just as good as those sweetened with sucrose. Imagine encouraging our children to chew gum every day! Serious anticaries research using xylitol goes back more than 40 years. In a research review[4], Dr Catherine Hayes of the Harvard School of Dental Medicine concluded that the favourable evidence for xylitol was so strong that "it would be unethical" to deprive people of its dental protective effects, which of course promoting fluoride and not mentioning xylitol definitely could do.

Controlling Bacteria in Our Mouths

We like to think of our mouths as clean places, but clean does not mean sterile or bacteria-free. As are many places in our bodies, our mouths are an ideal breeding ground for bacteria. The mouth is dark, moist, and warm, and all our food passes through it. It is estimated that the average mouth contains more than 400 species of bacteria, amounting to billions and billions of individual organisms.[5] Don't look now, but there are more bacteria in your mouth than there are people on Earth! Bacteria thrive in the mouth, and there's not much we can do about that. What we can do is control the growth of the most cariogenic (tooth-decay-causing) bacteria and prevent the damage these bacteria are capable of doing.

Fortunately, the vast majority of oral bacteria are completely harmless and even beneficial. We don't have to rid our mouths of virtually all bacteria, as some antimicrobial mouthwashes do temporarily. Instead, we can focus our antibacterial strategies to just a few species, which makes the task not only more effective, but safer. The microorganisms most responsible for tooth decay are *Streptococcus mutans*, with different bacteria causing periodontal disease, which primarily attacks the gums and bone that surround and support the teeth.

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When *S. mutans* feed on carbohydrates and sugars, they metabolise it by fermentation. When certain bacteria ferment the sugar in grapes, the result may be a fine chardonnay, but when *S. mutans* ferment the sucrose in our mouths, the primary product is lactic acid. When we chew a piece of sucrose-based gum or suck on a sucrose-based candy, our oral bacteria go to work within minutes churning out this acid. This results in a noticeable increase in the acidity (decrease in pH) in our mouths.

Bacteria-produced acid dissolves tooth enamel, even though tooth enamel is the hardest tissue in the human body. However, tooth enamel is highly vulnerable to a low pH (acidic) attack. For the same reasons that acid rain corrodes away the details from outdoor marble statues, bacteria-generated acid (in high enough concentrations) can literally dissolve away tooth enamel by a process known as demineralisation.

Demineralisation goes on all the time at a very low level, but it's balanced by a complementary process called remineralisation. Teeth have a limited ability to "remodel" themselves by reincorporating minerals (especially calcium) from saliva into the enamel. Thanks

to remineralisation, under the right conditions (not much acid concentration), even small caries can be covered over with newly minted enamel. It may not be enough to completely fill in the hole, but it can often seal the cavity from further erosion or infection. For remineralisation to succeed, *S. mutans* (which produce the demineralising acids) must be kept under control.

While most bacteria cannot live in an acidic environment, *S. mutans* thrives. Their ability to secrete acid and then live in it gives them (and other acid-loving microorganisms) a selective survival advantage. As they make the oral environment more and more acidic, they drive out other less harmful bacteria and take it over for themselves.

Sucrose ("regular" sugar) is a very big problem because it is the only carbohydrate that can be transformed by *S. mutans* into sweet, gooey substances known scientifically as *polysaccharides*. When *S. mutans* excrete polysaccharides through their cell membranes, they coat themselves with the sweet, sticky goo, allowing themselves to adhere to anything in their vicinity—especially dental enamel. Polysaccharides produced from sucrose are the glue that holds bacterial colonies together to form dental plaque. Plaque concentrates the acid right at the tooth surface, and because there is strength in unity, it also shields the individual bacteria and the acid they produce from contact with neutralising saliva. If these localised areas of high acidity are allowed to remain in place, they can lead to accumulated demineralisation—or caries.

These dental plaque bacteria process sucrose very rapidly. Lactic acid levels in the mouth rise rapidly (leading to lower pH) within minutes of putting any sucrose or sucrose-sweetened concoction into the mouth. But even these bacteria have their limits. *S. mutans* bacteria churn out acid as fast as they can and then sock away any excesses in the form of intracellular polysaccharides. So even if no sucrose at all is consumed, during "leaner", less sucrose consumption times, the bacteria don't have to miss a beat, because they can dip into their polysaccharide reserves to keep the acid (and sticky goo) flowing.

Preventing and Healing Dental Caries With Xylitol

Artificial chemical sweeteners, such as saccharine (Sweet'n Low®) and aspartame (Equal®, Nutrasweet®) should never be in human bodies as all of them are created in laboratories, and not found in Nature. By contrast, xylitol is a natural sugar. It is derived from sources such as fruit, berries, vegetables, birch wood, corn residues, straw, seed hulls, and nutshells, but we couldn't eat enough of these to obtain sufficient xylitol to produce a beneficial dental effect. Xylitol dissolves rapidly (quicker than sucrose) and has a pleasant, refreshing, cooling sensation, a clean sweet taste, with no aftertaste.[6]

Xylitol is scientifically classified as a sugar alcohol, or polyol. Small amounts of xylitol are also produced in the human body as a result of some normal metabolic processes. Other sugar alcohols, including sorbitol and mannitol, offer some anticaries benefits similar to xylitol but are generally less effective. Unlike sucrose, xylitol (along with other sugar alcohols, to varying degrees) has physical and chemical properties that do not promote caries. In fact, xylitol can actually support remineralisation—restoration of tooth enamel—where caries have already started.

Scientific research evaluating the systematic use of xylitol chewing gum and other products in the prevention of dental caries has been available for more than 40 years. The first studies and many of the more recent ones were conducted at the University of Turku, Finland. Since then, numerous studies from Finland, Hungary, and other countries have been virtually unanimous in concluding that xylitol (and to a lesser extent, other sugar alcohols) reduces the incidence of dental caries both in children and adults.

A Finnish study evaluated xylitol in 10- to 11-year-old school children, who had been participating in a rigorous dental hygiene program that included regular brushing and flossing, dietary instruction, systematic checkups, and use of fluorides. Because this program was so intense, the local dental and school authorities believed that the addition of xylitol to this regimen would have little or no benefit. They couldn't have been more wrong! Having some of the children chew xylitol gum daily significantly increased protection by nearly 50 per cent! Children whose final permanent teeth grew during the trial were the best protected.[7]

In a double-blind study conducted in Belize, 1,277 school children stopped everything several times each day to chew gum. Some of the children chewed ordinary gum sweetened with sucrose, while others chewed gum sweetened with either xylitol or sorbitol. After up to 40 months of daily gum chewing (including weekends and

vacations), the xylitol group experienced 73 per cent fewer caries, compared with a reduction of 26 per cent in the sorbitol group and an increase of 120 per cent in the sucrose group.[8]

Further studies in Belize and other countries have yielded similar findings. For example, researchers in Estonia evaluated the use of xylitol gums and candies in 10-year-old school children. Overall, three years of xylitol gum chewing, compared to a no-gum control group, resulted in a 53.5 per cent reduction in caries, while sucking on xylitol candy led to a 33–59 per cent reduction. These results were statistically significant.[9]

Most xylitol research has tested gums or candies, but one study from Costa Rica compared a xylitol-sweetened toothpaste with a control toothpaste. Both products contained fluoride. (This research was done before the reports about fluoride significantly lowering children's IQ were published.) After three years of twice-daily brushing, the xylitol group had statistically significantly fewer caries (10.5–12.3 per cent), depending on the tooth surface examined.[10]

Reversing Tooth Decay With Xylitol

Many of us think that once caries get started, the only solution is a dentist's drill, but "it ain't necessarily so". Research has shown that xylitol can arrest the progress of caries and eventually restore their enamel coating, essentially healing them.[11] This was clearly demonstrated in another study in Belize school children. The xylitol group had the highest percent of arrested caries (27 per cent), compared with the sorbitol (seven per cent) and no-gum control (nine per cent) groups.[12]

Long-Term Effectiveness

One of the more remarkable things about the caries protection provided by xylitol is that, to a large degree, it is permanent. Research tells us that if we use xylitol products regularly for a period of time, perhaps two years, we may be protected after that, even if we never chew another piece of xylitol gum. This was demonstrated most clearly in another school-based study in Belize children, who were six years old on average when the study started. For two years, they chewed gum sweetened with either xylitol or sorbitol, while a control group had no gum. Then, five years later, their teeth were examined by dentists who did not know which treatment they had received. The xylitol group had a mean of only 1.5 new caries, compared with 2.5 for the sorbitol group, and 4.0 for the no-gum group. Overall, use of xylitol was associated with a statistically significant 59 per cent reduction in caries risk. The long-term caries risk depended strongly on when the children's permanent teeth erupted. Those teeth that erupted during the second year of xylitol gum chewing were almost completely protected from caries (93 per cent risk reduction). Even teeth that erupted after the children stopped chewing xylitol gum had substantial (88 per cent) protection.[13]

This was a very important study because it showed that if children get in the habit of chewing xylitol gum (and/or using other xylitol products, as well) at an early enough age—at least one year before their permanent teeth erupt—they will likely be protected from tooth decay for the rest of their lives.

Mothers, Children, and Tooth Decay

To a large degree, tooth decay is a transmissible disease, at least when it comes to mothers and babies. A study[14] from the University of Turku, in Finland, demonstrates this in dramatic fashion.

These pioneering Finnish dental investigators, who have been at the centre of xylitol research from the beginning, recruited 169 pregnant women who had high oral levels of *S. mutans* and placed them all on a standard oral health care program. In addition, the women were divided into three groups:

- Xylitol. These women were given xylitol-sweetened gum and instructed to chew it at least two to three times per day for two years, beginning three months after delivery.
- Chlorhexidine. Chlorhexidine is an antimicrobial substance that has been used to kill oral bacteria for more than 40 years. It is commonly used in mouth rinses and by direct application to the teeth in gels or varnishes. The women in this group received chlorhexidine "varnish" treatments from their dentist at six, 12, and 18 months after childbirth.
- Fluoride. Fluoride is a mineral that helps harden tooth enamel when applied to the tooth surface. Despite the Harvard and Canadian research mentioned above, fluoride is still often added to municipal water supplies and is commonly applied directly to teeth by dentists or

individuals using fluoride-containing toothpastes and other products. Fluoride has no effect on bacteria. The women in this group, like those in the chlorhexidine group, received topical applications of fluoride from their dentists at six, 12, and 18 months after delivery.

The results left no doubt that mothers with *S. mutans* in their mouths are capable of passing the bacteria on to their babies, probably through kissing and other innocent motherly contact. However, if mothers take steps to minimise *S. mutans* in their own mouths, they're doing their children a big favour as well. Maternal chlorhexidine treatments had a small effect, resulting in *S. mutans* growing on the teeth of nearly one child in three. Compare that with the xylitol mums, where only one child's mouth in ten eventually harboured *S. mutans*. This was five times better than the fluoride group, where the treatments may have helped the mother some, but were useless for the child.

However, the children of the mothers who chewed xylitol gum continued to be protected against tooth decay at least through age five, despite using nothing more than normal dental hygiene.

In a follow-up to this study, the researchers found[15] that this mother–child bacterial reduction led to healthier teeth. They examined the children's teeth each year, up to age five. Neither maternal fluoride nor chlorhexidine had any lasting benefit for the children once their mothers stopped using them. However, the children of the mothers who chewed xylitol gum continued to be protected against tooth decay at least through age five, despite using nothing more than normal dental hygiene.

Preventing Tooth Decay in Adults

Although most of the research on xylitol has been carried out in children, adults can derive real benefits as well. The adults at greatest risk are those who have poor oral hygiene due to illness, advanced age, or just bad habits.

Adults who suffer from a condition known as "dry mouth" syndrome (*xerostomia* for the technically inclined) are also at risk because their ability to salivate is impaired. People who do not salivate enough are at increased risk for dental caries, because saliva normally helps neutralise bacterial acids and rinse bacteria and carbohydrates away from the teeth and out of the mouth. Dry mouth can be a side effect of many medications, and it can also occur as a result of certain diseases, such as Sjögren's syndrome, and radiation therapy to the head or neck. Chewing xylitol gum or sucking on xylitol candy is an effective and pleasant way to stimulate salivation and has

(Image: nz.iherb.com)

been shown to significantly reduce the incidence of caries in adults who use it regularly.[16,17] While most candies or gums would satisfy this need just as well, xylitol has the further advantage of discouraging the growth of cariogenic bacteria. This was demonstrated most clearly in an important study published[18] in the *Journal of the American Dental Association* in which 151 people, who were first treated with an oral antimicrobial mouth rinse containing chlorhexidine for two weeks, had their oral bacterial levels measured immediately after disinfection, and again three months later.

The participants were randomly assigned to chew either xylitol gum, sorbitol gum, or no gum beginning immediately after disinfection. By three months, bacteria had grown back to their pre-disinfection levels in both the sorbitol and no gum groups, but only to about one-third of their pre-disinfection levels in the xylitol group, a statistically significant difference.

How Does Xylitol Prevent Dental Caries?

In medical terms, the ability of a substance to promote tooth decay is termed its cariogenicity. As we have discussed, although xylitol and sucrose are both naturally occurring sugars, xylitol is far less cariogenic than sucrose. What is it about xylitol that makes it so much more compatible with good dental (not to mention general) health than sucrose? Xylitol's superiority seems to derive primarily from three factors:

1. Cariogenic bacteria process xylitol very poorly. Cariogenic bacteria are almost entirely dependent on carbohydrates, especially sucrose and common starches, for energy production and growth. In the presence of sucrose, cariogenic bacteria thrive, churning out lots of tooth-dissolving acid and encouraging the reproduction of new generations of bacteria. But, when they are

deprived of sugar, their cariogenic acid production is seriously impaired. In the absence of bacterial acids, tooth enamel is safe from decay. Although xylitol tastes just as sweet as sucrose to our human tongues, bacteria find it very unappealing. *S. mutans* tend to "gag" on xylitol, fermenting it very slowly, which produces very small amounts of acid.[19]

2. Xylitol prevents bacteria from sticking to tooth enamel. When *S. mutans* ferments sucrose or some other sugars, it produces not only lactic acid, but also a sticky polysaccharide that glues microorganisms together in plaques on the tooth surface. This concentrates acid on the dental enamel, eventually leading to caries. Xylitol does not promote plaque formation, because bacteria do not ferment it, do not use it to produce sticky polysaccharide, and therefore do not form plaques that allow them to adhere to the tooth surface.[19]

3. Xylitol promotes the colonisation of less virulent strains of bacteria in the mouth. Bacteria are remarkably adaptable creatures. If their environment becomes less hospitable, most of them may die off, but some of the microorganisms may develop—by pure chance—a genetically determined ability to survive and perhaps even thrive under the changed conditions. When these "resistant" bacteria reproduce, they pass on their genetic advantage to the next generation, which will thrive until something else changes the mix. The development of bacterial resistance is a textbook example of "survival of the fittest." Among physicians who treat infections with antibiotic drugs, bacteria that become resistant to all kinds of drugs are a nightmare that is rapidly coming true.

We might wonder, then, if xylitol "attacks" *S. mutans* by making life increasingly miserable for them, isn't it possible that at some point a genetic mutation will occur such that some of the bacteria will learn to "love" xylitol and begin to thrive again? It is true that, in time, the regular usage of xylitol can lead to a shift in the nature of *S. mutans* that grow in the mouth. However, the natural mutants selected by xylitol are generally friendly, benign creatures that learn to ferment xylitol very slowly, do not produce polysaccharides, and do not stick very well to each other or to our teeth. Thus, they contribute very little to the formation of cariogenic plaques. Most importantly, their presence keeps out the more virulent strains, so our mouths stay healthy.

Remember, we mentioned earlier that when mothers start chewing xylitol gum shortly after giving birth, their children don't get cavities? The reason for this can now be traced to the development and transmission of these "friendly" strains of bacteria. Once established in the mother's mouth, she passes them on to her baby. Once established in the baby's mouth, they crowd out the cariogenic varieties, providing them with essentially permanent protection against tooth decay.

Getting the Most Out of Xylitol

Xylitol is available in chewing gums, candies, toothpastes, breath sprays, breath mints, mouthwashes, calcium supplements, and chewable medications, and vitamins. The "delivery systems" that produce the best anticaries effects are those that permit xylitol to come in direct contact with the teeth for the longest time. These include chewing gums, especially "pellet-type" gums that have pure xylitol candy coating. Chewy, sticky, hard, or tablet candies made with a large proportion of xylitol are also quite effective.

How Much Xylitol Is Enough?

Studies show that using about four to 12 grams of xylitol per day is very effective for preventing dental caries. If a piece of gum contains one gram of xylitol, then chewing four pieces per day should be sufficient. So read product labels carefully, and, when in doubt—because it's so safe—it's best to use more rather than less. Children can usually tolerate up to 45 grams per day, way more gum than even the most "gum-addicted" child would ever want to chew.

How Often Should Xylitol Be Used?

How often we use xylitol products may be more important than how much we use at any particular time. Clinical experience suggests that three times a day provides minimum effectiveness, while five times a day is ideal.

When Should We Use Xylitol?

Children should start chewing xylitol gum at least one year before their permanent teeth begin erupting. (To make sure, start no later than 4 to 4½ years of age.) Studies show that teeth treated this way will be strong and have long-lasting protection.[13] In fact, children who use xylitol may have just as much protection as that provided by dental sealants.[20]

Adults can achieve the best results by first going to the

dentist for a regular oral prophylaxis procedure that includes full-mouth disinfection.[21,22] After that, chewing xylitol gum regularly, as described above, can help keep cariogenic bacteria suppressed. Everyone should use xylitol immediately after every meal or snack. Chewing xylitol gum between meals is also recommended. Only about three to five minutes of chewing is required. Beyond that, the xylitol content is generally depleted.

Does Using Xylitol Mean We Can Safely Eat Sucrose-Containing Products at Will, Too?

Xylitol works best when it is the only sugar present. Thus, it is still best to avoid foods that contain sucrose or a mixture of xylitol and sucrose or other caries-promoting carbohydrates, like starches, because these serve to dilute its effect. The old advice of limiting sweet between-meal snacks, still applies, as does brushing after every meal and flossing daily. Xylitol is a very effective product, but it's not a guaranteed "get-out-of-caries-free card".

Who Can Benefit Most From Xylitol?

Anyone can benefit from reducing cariogenic bacteria, but, as with most health conditions, some people are more at risk for dental caries than others are. Those at higher risk need to take more precautions and use xylitol more often. These include people who have: rampant caries, poor oral hygiene, a history of dental neglect, deficient manual dexterity due to illness or injury, conditions that make mechanical plaque removal more difficult, such as extensive restorations, bridges, removable partial dentures, cosmetic restorations, orthodontic appliances, or dental implants, and athletes who consume sucrose-sweetened sports beverages.

How Safe Is Xylitol?

In the amounts found in (and recommended for) dental health, xylitol is extremely safe. However, if xylitol is consumed in very large amounts (more than 20 grams or 0.7 ounces) per meal or more than 60 grams (2.17 ounces) per day, it can cause diarrhoea in some sensitive people, but even these people eventually adapt to these high levels. The amounts recommended for dental protection (up to 12 grams per day) should never cause anyone any problems.[6]

"Third World" Research, "First World" Benefits

You may have noticed that virtually all the research we have discussed regarding xylitol has been conducted in places like Belize, Estonia, Hungary, and Costa Rica. One reason for this is that "third world" or "developing" countries, which often lack the resources for good public health programs, are always looking for effective, safe, easy-to-use, but inexpensive ways to improve people's health. Xylitol as a treatment for tooth decay fits perfectly into this model.

In places where routine dental care may be limited to extractions of abscessed teeth, urging people to brush after each meal with Crest®, floss daily, and see their dentist twice a year for professional cleanings is not very realistic. In places like these, the caries prevention provided by xylitol represents an enormous potential breakthrough in public health.

With all of this scientific evidence, in 2002, the *Journal of the American Dental Association* published an article recognising xylitol as "an effective preventive agent against dental caries."[23]

With all of this scientific evidence, in 2002, the *Journal of the American Dental Association* published an article recognising xylitol as "an effective preventive agent against dental caries."

In April 2001, in a very, very rare gesture for a natural product not promoted by a major patent medicine company, the FDA "approved" sugar alcohol as a product which "does not promote" and "may reduce the risk of" dental caries. But FDA did not tell us—despite clear scientific evidence—that xylitol is much more effective than other "sugar alcohols" such as sorbitol or mannitol. At about the same time, the National Institutes of "Health" (NI"H")—in a major consensus statement—endorsed xylitol as one of many preventive measures for dental caries!

Apparently, they've since "forgotten"! As noted above, all that's mentioned on their website[3] is IQ-lowering fluoride. NI"H" also publishes (in several languages) downloadable booklets[24] titled *A Healthy Mouth for Your Baby* which recommends IQ-lowering fluoride and totally neglects to mention xylitol!

Has Your Dentist Ever Told You About Xylitol?

Of all the dentists ever consulted, only one has mentioned xylitol and urged me to use it! If you didn't know all these research-proven scientific facts above about xylitol before, now you do, so "spread the word" to your family, friends, and neighbours, and maybe even urge your local "water board" to quit lowering children's IQ potential with fluoridated water!

Thank you to Lane Lenard, PhD for helping to find information and write (along with me) a prior booklet (2003) on this topic.

About the Author:

Jonathan V. Wright, MD is founder of the Tahoma Clinic (1973), where he practices exclusively natural medicine and serves as Medical Director, Meridian Valley Laboratory (est. 1976), and the Tahoma Clinic

Foundation (1996), all in Washington State. The infamous 1992 FDA armed raid on the Tahoma Clinic ("The Great B-Vitamin Bust") inadvertently popularised the clinic and natural medicine, with Dr Wright's ensuing struggles (and eventual acquittal) serving as a major impetus for Congressional reform of vitamin/mineral regulation. He continues to be an outspoken advocate for freedom of choice in healthcare.

Dr Wright has authored or co-authored 13 books, selling over 1.5 million copies. Since 1996 he has written a popular monthly newsletter emphasising nutritional and naturally based medicine with a wide-reaching distribution. His articles "Introducing Gastropause", "Iodine for the Prevention and Treatment of Breast Cancer", "A Cure for Gestational Diabetes", and "Niacinamide for Osteoarthritis Pain" appeared in NEXUS 27/01, 26/04, 24/04, and 24/05 respectively.

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