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GI News is published online by the University of Sydney, School of Life and Environmental Sciences and the Charles Perkins Centre, and delivered to the mailboxes of our 97,000 subscribers. Our goal is to help people choose the high-quality carbs that are digested at a rate that our bodies can comfortably accommodate and to share the latest scientific findings on food and diet with a particular focus on available carbohydrates (maltodextrins, starches, sugars), dietary fibres, blood glucose, the glycemic index and glycemic load.

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FOOD FOR THOUGHT
RICE AND RISK OF TYPE 2 DIABETES

Around the world, the prevalence of type 2 diabetes continues to climb. The rate of increase is particularly high in countries such as China and India, the most populous nations on the planet. China and India are also similar in the sense that rice is their staple food. Although there have been changes in lifestyle, nutrition and physical activity, rice remains a favourite food. Indeed, rice provides about 20% of all calories eaten globally. White rice is still preferred over brown rice, but there have also been more subtle changes in milling and polishing that have altered the inherent nutritional properties of rice.

A long time ago, I recall reading a magazine article about the many different varieties of rice. Even though I had already devoted 4 years to training in Food Science, I was amazed to learn that ordinary people distinguished between different types of rice, favouring one versus another, depending on the cuisine. To me, at that time, rice was rice! I learned that some people liked Jasmine best - the grains were fluffy and slightly sticky. They clumped together, making them ideal for eating with chopsticks. Other varieties such as Basmati were not at all sticky and individual cooked grains could be picked out one at a time. Basmati was the favourite for curries and other Indian dishes.

Today, we can find many varieties of rice on supermarket shelves, including short grain, long grain, medium grain, Arborio (ideal for making risottos) and sushi rice (short-grain Japanese rice) for making sushi. There's also black rice, red rice, wild rice and *Doongara* (Clever Rice™) – a new variety developed in Australia to compete with Basmati.

One of the first research projects that I was to carry out as a scientist was on the GI of different rices sold in Australia. We compared 10 different rice products – 3 were commercial rices with different levels of amylose starch, a waxy variety with only 2% amylose, a converted (parboiled) rice, a quick cooking brown rice, puffed rice cakes, rice pasta and rice bran. Amylose starch is a straight-chain molecule that lines itself in rows, making it more difficult to gelatinise than the other form of starch called amylopectin. Higher temperature and more water is needed to cook high amylose varieties of rice.

The GI values varied, ranging from medium to high on a scale where glucose = 100. The low amylose Pelde variety gave the highest GI (93), while the high amylose rice gave the lowest GI (64). The quick-cooking brown rice also had a very high GI (80), as did the brown rice pasta (92). Interestingly, white rice and brown rice have similar GIs. It was the variety that was important, rather than the grain size, degree of milling or parboiling.

So here once again, the GI concept turned conventional nutrition wisdom on its head. It was wrong to automatically assume that a brown rice would have a lower GI than white varieties.

In November 2020, the prestigious journal *Diabetes Care*, carried a paper and editorial about the link between eating rice in large amounts and the risk of developing type 2 diabetes. The PURE study was an observational study in over 130,000 individuals from 21 countries. On average, people were followed-up for 10 years, during which time just over 6000 developed diabetes.

The authors found that those who ate more than 450 g per day (that's around 2.5 cups of cooked rice) were more likely to have a diagnosis than those who consumed less than 150 g per day (less than 1 cup). In scientific wording, their risk was 20% more.

However, people from South Asia (India) were substantially (60%) more likely to have developed diabetes when rice was eaten in large amounts. People from South East Asia, the Middle East, South America and Africa were also more at risk, but not as much as those from South Asia. Surprisingly, there was no association between the amount of rice consumed in China and the risk of diabetes.

These mixed findings are difficult to explain on the grounds of differences in GI alone. We know that a diet with a higher GI and glycemic load will increase the risk of type 2 diabetes, but in the PURE study, the *lower* GI variety (Basmati) is associated with *more* diabetes than the higher GI variety consumed in China.

There are other possible explanations, e.g., the presence of toxic elements such as arsenic in rice grown in India. Also, some have interpreted the results of the PURE study as an indicator of a "poverty diet", rather than nutrition. Most study participants located in low-income countries subsisted almost entirely on carbohydrates, "*especially from refined sources*." A "*poverty diet*", which is common in poor rural areas, is also typically high in sodium and low in animal products and vegetable oils. In this situation, it is extremely challenging if not impossible to separate the effects of diet from poverty and undernutrition.

Indeed, the South Asian (Indian) diet is higher in saturated fat (ghee is a popular cooking fat) that increases insulin resistance and the demand for insulin secretion. Over time, insulin resistance worsens, and the beta-cells eventually fail, despite the rices lower GI. Moreover, in China, the alternative to high GI rice is a large range of wheat products (including bread and dumplings) that also have a high GI.

And finally, as I often say to my students and colleagues, nutrition science is still very young, it's very complex and we have lots to learn.

Read more:

- White Rice Intake and Incident Diabetes: A Study of 132,373 Participants in 21 Countries
- PURE study makes headlines, but the conclusions are misleading
- Dietary Glycemic Index and Load and the Risk of Type 2 Diabetes: A Systematic Review and Updated Meta-Analyses of Prospective Cohort Studies

Professor Jennie Brand-Miller holds a Personal Chair in Human Nutrition in the Charles Perkins Centre and the School of Life and Environmental Sciences, at the University of Sydney. She is recognised around the world for her work on carbohydrates and the glycemic index (or GI) of foods, with over 300 scientific publications. Her books about the glycemic index have been bestsellers and made the GI a household word.

WHAT'S NEW?
WHOLEGRAINS AND RISK OF DIABETES

A new study published in the *British Medical Journal* has found that a higher intake of wholegrains is associated with a lower risk of developing type 2 diabetes.

Researchers combined the findings from three large prospective cohort studies – the Nurses' Health Study, The Nurses' Health Study 2 and the Health Professionals Follow-Up Study. Together, they included 158,259 women and 36,525 men who did not have type 2 diabetes, cardiovascular disease, or cancer when the studies began. Participants completed a dietary questionnaire at the start of the study and every four years, and another questionnaire to identify newly diagnosed type 2 diabetes and other health conditions every two years. The average follow-up period was 24 years.

In this study, the researchers looked specifically at intake of total and individual whole grain foods and the risk of type 2 diabetes.

After adjusting for other lifestyle and dietary factors which might affect diabetes risk, participants with the highest intakes of wholegrains had a 29% lower risk of type 2 diabetes compared to those with the lowest intakes.

The researchers also looked at specific wholegrains including wholegrain breakfast cereals, wholegrain breads, oatmeal and brown rice. People who ate 1-2 serves of wholegrain cereal or breads per day had around a 20% lower risk of developing diabetes compared to those who ate these foods less than once per month. And those who ate oatmeal or brown rice once or twice per week had a 21% and 12% lower risk, respectively, than those who ate these foods less than once per month. Physical activity, family history of diabetes and smoking status didn't affect the findings but the association between wholegrain intake and diabetes risk was stronger in those who were lean compared to those carrying excess weight.

These findings are consistent with previous studies showing a lower risk of type 2 diabetes associated with wholegrain, but not refined grain, intake. When it comes to rice, previous research has found that higher intakes of white rice were associated with an increased risk of type 2 diabetes and it was estimated that replacing 50g (uncooked) per day of white rice with brown rice could reduce diabetes risk by 16%.

Read more:

- Hu Y, and colleagues. Intake of whole grain foods and risk of type 2 diabetes: results from three prospective cohort studies. BMJ. 2020.

- Sun Q, and colleagues. White rice, brown rice, and risk of type 2 diabetes in US men and women. Arch Intern Med. 2010.
- Aune D, and colleagues Whole grain and refined grain consumption and the risk of type 2 diabetes: a systematic review and dose-response meta-analysis of cohort studies. Eur J Epidemiol. 2013.

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PERSPECTIVES: DR ALAN BARCLAY
RICE: THE GO-TO GRAIN

你吃了飯嗎

English translation: “Have you eaten rice?”

This popular greeting used throughout East Asia is a reminder that traditionally food was scarce and people were often starving. Rice saved lives, so it’s not surprising that the word for “rice”, “food” and “meal” is one and the same in Chinese—and in many other parts of East Asia, too.

Those early farmers who planted the first seeds some 10,000 to 8,000 years ago in Southern China would be gobsmacked at the number of varieties that have evolved (more than 100,000 it is estimated) and at their colours (white, red, black), sizes, shapes, aromas, stickiness and starchiness. And at all the things we make with the grains from flour, noodles, and crackers to syrup, alcohol, oil and puffed breakfast cereals.

In wok, pot or bowl or on a plate, rice soaks up the flavours from stocks and sauces and partners with meat, chicken, fish, seafood, tofu, vegetables, nuts, or fruit in snacks, soups, salads, sides, pilafs, paellas, risottos, desserts and more.

WHAT TO LOOK FOR
Nutty-tasting brown rice with just the inedible hull removed is the rice with the serious nutritional wholegrain credentials. This is because it contains all parts of the grain — including the fibrous

bran, the nutrient-rich germ and the starch-rich endosperm. Because of this, brown rice has more dietary fibre, antioxidants, vitamins and minerals than white rice. But it tends to be slow cooking.

However, these days we can buy 2-minute microwave options to help get meals on the table fast. Refined, popular, palatable white rice is still an ok choice, especially when combined with lots of veg. For speedy meals rice noodles are good to have on hand. Look for lower-GI varieties.

LOWER GI RICES - THE AMYLOSE FACTOR

The starch in raw food is stored in hard, compact granules that our bodies find hard to digest, which is why starchy foods usually need to be cooked. Water and heat expand the starch granules during cooking to different degrees; some actually burst and free the individual starch molecules (this is gelatinisation). Rice is a great grain for getting to know the starches in our foods— amylose and amylopectin.

- Amylose is like a string of glucose molecules that tend to line up in rows and form tight, compact clumps that are harder to gelatinise and digest. The lower GI rices have a higher proportion of amylose.
- Amylopectin is a string of glucose molecules with lots of branching points, such as you see in some types of seaweed. Amylopectin molecules are larger and more open and the starch tends to be easier to gelatinise and digest. Higher GI rices have a higher proportion of amylopectin.

Adapted from *The Good Carbs Cookbook*, by Dr Alan Barclay, Kate McGhie & Philippa Sandall.

Published by Murdoch Books.

Dr Alan Barclay, PhD, is a consultant dietitian and chef with a particular interest in carbohydrates and diabetes. He is author of *Reversing Diabetes* (Murdoch Books), and co-author of 30-plus scientific publications, *The Good Carbs Cookbook* (Murdoch Books), *Managing Type 2 Diabetes* (Hachette Australia) and The *Ultimate Guide to Sugars and Sweeteners* (The Experiment Publishing).
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DIABETES CARE
RICE AND THE MANAGEMENT OF DIABETES

Due in part at least to the current popularity of “low carb” diets, people with diabetes are often advised to at the very least severely limit, if not completely avoid rice. This is of course a major issue for people who traditionally eat rice for all of their main meals (breakfast, lunch and dinner), like many people from South and East Asia. For these people, complete avoidance is not really a long-term strategy for success, as it goes against their cultural and personal food preferences. What are the alternatives, if any?

Portion caution

Cooked rice is indeed a concentrated source of starchy carbohydrate. As can be seen in this month's "Your GI Shopping Guide", a quarter of a Cup of most cooked rices provides around one carbohydrate exchange (12-18g carbohydrate per serve). While everyone with diabetes should see a dietitian for personalised advice, as a general guide, the carbohydrate recommendations for main meals for adults are:

Men 45 – 60 grams of carbohydrate, or 3 – 4 exchanges

Women 30 – 45 grams of carbohydrate, or 2 – 3 exchanges

So, if you are going to continue to enjoy rice for breakfast, lunch and dinner, aim to have less than 1 cooked Cup at each meal. Bulk the meal out with non-starchy vegetables (e.g., alfalfa sprouts, asparagus, bean sprouts, bok choy, broccoli, Brussel's sprouts, cabbage, capsicum, cauliflower, celery, chives, cucumber, eggplant, endive, garlic, green beans, kale, lettuce, leeks, marrow, mushrooms, okra, onions, radish, rocket, shallots, silverbeet, spinach, squash, tomatoes, watercress, and zucchini) and some lean protein (e.g., eggs, lean meat, seafood, skinless poultry or tofu).

Swap it, don't stop it

There are literally thousands of varieties of rice grown around the world. We have measured the GI of only a small portion of them. While many varieties have a high GI (>70), not all varieties do. Lower GI varieties are becoming increasingly available in both South and East Asia, to suit the culinary needs of the local population. See this month's "Your GI Shopping Guide" for some more common examples and ideas.

Glycemic load counts

The glycemic load (GL) is the amount of available carbohydrate (grams) in a serve of food, multiplied by its GI value (which is a percentage):

GL = available carbohydrate per serve X GI value ÷ 100.

Each unit of GL is equivalent to 1 gram of pure glucose – the sugar people measure in their blood with their home blood glucose meter when they have diabetes.

So, by choosing the lower GI variety of your favourite rice, and eating it in smaller portions, you can potentially cut the glycemic impact of the rice you eat in half.

Long-term success

For those people who have enjoyed eating rice for their main meals for most of their life, complete avoidance or severe restriction is not a recipe for long-term success. As the scientific evidence base shows us, many people can adhere to a "low carb" diet for 6 months, but most can't for 12 months or more. It is therefore arguably better to enjoy a smaller amount of high-quality rice on a regular basis, than to try to avoid it.

Read more:

- Diabetes Australia: What should I eat
- National Diabetes Services Scheme: Carbohydrate counting and diabetes
- Effect of dietary carbohydrate restriction on glycemic control in adults with diabetes: A systematic review and meta-analysis

Dr Alan Barclay, PhD, is a consultant dietitian and chef with a particular interest in carbohydrates and diabetes. He is author of *Reversing Diabetes* (Murdoch Books), and co-author of 30-plus scientific publications, *The Good Carbs Cookbook* (Murdoch Books), *Managing Type 2 Diabetes* (Hachette Australia) and The *Ultimate Guide to Sugars and Sweeteners* (The Experiment Publishing).
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YOUR GI SHOPPING GUIDE
WHICH RICE?

Preparing this article on the GI of rice turned out to be way more difficult than I anticipated. There are literally hundreds of studies that have looked at the GI of rice and identified virtually as many GI values! I've chosen just a few varieties of rice to profile in this month's shopping guide, and simplified the evidence, but if you would like to read more see the reference below.

Generally, rice should be considered a medium to high GI food with the potential to contribute a significant glycemic load to our diet. To moderate its glycemic impact you could consider:

- *Species* - high amylose rice (think long, firmer grains that expand less during cooking) has lower GI values than high amylopectin varieties (think shorter grain, waxy, sticky or glutinous rice)
- *Preparation technique* - shorter cooking times and steaming, rather than boiling, tend to lower GI. Cooling cooked rice by refrigeration increases resistant starch and lowers the GI
- *Accompaniments* - eating rice with vinegar (as in sushi) or with pickled foods can lower the GI, as can incorporating soluble fibres such as those from barley and legumes

And finally

- *Portion size* - a smaller serve will have a lower glycemic load

For people with diabetes – To those of you who count your carbohydrate intake in grams, exchanges or portions, we have included the details for each of these.

15g carbohydrate exchange – a serve containing 12-18g carbohydrate.
10g carbohydrate portion – a serve containing 7.6-12.5g carbohydrate.

Arborio, risotto rice, boiled

GI 69

Serving: 1 cup (170g/6oz)

Energy	Available carbohydrate	Exchanges	Portions	Glycemic load
1189kJ/283Cal	61g	4	6	42

Basmati rice (medium amylose), white, boiled

GI 43-69.

Serving: 1 cup (165g/6oz)

Energy	Available carbohydrate	Exchanges	Portions	Glycemic load
1138kJ/ 271Cal	58g	4	6	25-40

Broken Rice (Thai- cooked in rice cooker)

GI 86

Serving: 1 cup (170g/6oz)

Energy	Available carbohydrate	Exchanges	Portions	Glycemic load
930kJ/ 222Cal	47g	3	5	40

Brown rice, high amylose

GI 50-66

Serving: 1 cup of cooked rice (210g/7.5oz)

Energy	Available carbohydrate	Exchanges	Portions	Glycemic load
1072 kJ/256 Cal	52 g	3.5	5	26-34

Cambodian Fragrant Rice long grain white

GI 62

Serving: 1 cup of cooked rice (200g/7oz)

Energy	Available carbohydrate	Exchanges	Portions	Glycemic load
1029kJ/245 Cal	57g	4	6	35

Glutinous rice, boiled or cooked in rice cooker (low amylose)

GI 75-98

Serving: 1 cup of cooked rice (174g/6oz)

Energy	Available carbohydrate	Exchanges	Portions	Glycemic load
707kJ/ 169Cal	35g	2	3.5	26-35

Jasmine rice, white, cooked in rice cooker or boiled

GI 79-109

Serving: 1 cup of cooked rice (200g/7oz)

Energy	Available carbohydrate	Exchanges	Portions	Glycemic load
1567kJ/ 373Cal	68g	4	6	54-74

Low GI, high amylose, white rice, Doongara, Rice Growers Australia

GI 54

Serving: 1 cup of cooked rice (220g/8oz)

Energy	Available carbohydrate	Exchanges	Portions	Glycemic load
1640kJ/390Cal	73g	5	7	39

Red Rice (Sri Lankan, cooked in rice cooker)

GI 59

Serving: 1 cup of cooked rice (170g/6oz)

Energy	Available carbohydrate	Exchanges	Portions	Glycemic load
1160kJ/280Cal	56g	4	5.5	33

Read more:

- Kaur, and colleagues. The glycemic index of rice and rice products: a review, and table of GI values. Critical Reviews in Food Science and Nutrition, 2016.

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GOOD CARBS FOOD FACTS
BLACK RICE

Have you noticed a trend toward black foods, such as bread with charcoal, black seaweed, black sesame and squid ink? Perhaps this is because they are unusual, or because they look great and really 'pop' on the plate making for Instagram (black) gold. Black rice is another black food that is enjoying popularity and is now widely available.

Black rice is a variety of regular rice *Oryza sativa.* In ancient China black rice was known as forbidden rice as only the wealthy could afford it. Now you can buy it in the supermarket, although it is a little more expensive than regular rice. I've seen it labelled as a 'super food' and while we may not be used to seeing rice labelled this way, it does have something special. The black colour is due the presence of an antioxidant called anthocyanin, which is also found in blue and purple fruits and vegetables such as berries, grapes, plums and cabbage. Besides looking gorgeous, anthocyanins are also good for you because they have antioxidant and anti-inflammatory properties that might help reduce the risk of numerous diseases such as cardiovascular disease, type 2 diabetes and even cancer. This sounds pretty 'super' to me, but I think lots of foods are super. It is also a good source of magnesium and a source of B-vitamins thiamine and niacin, and 1 cup of cooked black rice has just over 3g of fibre as most black rice is wholegrain and still has its bran layer. Black rice is naturally gluten free and offers a bit of excitement and variety in a gluten-free diet for those with coeliac disease or gluten intolerance.

Many rice varieties have a high glycemic index (GI), several have medium GI, but unusually black rice appears to have a low GI. There is only one black rice listed on the GI database, and it is a Chinese black rice porridge that has a GI of 42 (low). With most rices the main determinant of GI is the balance of the two main starches present, amylose and amylopectin. However, in black rice it is likely that the high levels of anthocyanin antioxidant is also slowing down the absorption of the carbohydrate and thus lowering the GI.

Black rice keeps its shape and is chewier than polished white rice and has a nutty flavour. It also takes longer to cook, around 35 minutes. To save time, try cooking up a big batch, freeze meal-sized portions and take one out as you need it. Black rice is perfect for rice salads, rice bowls, pilafs, risotto, paella, fried rice and as a base for curries and stir-frys and even as a sweet rice pudding dessert.

Good Carbs Food Facts **Black rice**	
★ ★ ★ 1/2	
Glycemic index 42	
Serving size – 1 Cup, boiled (210 g or 7.5 oz)	
Kilojoules	1270
Calories	304
Protein	6g
Fats – Total Includes: –Saturated fat –Polyunsaturated fat –Mono-unsaturated	0 0 0 0
Saturated : unsaturated fat ratio	N/A
Carbohydrates – Total *Available* Includes: –Natural sugars –Natural starches –Added sugars –Added starches *Unavailable* Includes: –Dietary fibre	70g 70g 0g 67g 0 0 3g 3g
Sodium	11mg
Glycemic load	29
Diabetes exchange	5
Ingredients: Black rice, water.	

Source: USDA, 2020

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GLYCEMIC INDEX FOUNDATION NEWS
SWAP IT, DON'T STOP IT

The GI Foundation (Australia) has a handy Swap It tool that you can use to find healthy lower GI alternatives to your favourite foods, like rice.

Read more:

- www.gisymbol.com

THE GOOD CARBS KITCHEN
GOLDEN RICE WITH PEAS AND CASHEWS
0:10 Prep • 6 Serves • Side dish • Every day

INGREDIENTS
1½ cups (300 g) basmati rice
1 tablespoon vegetable oil
4 whole cloves
1 small cinnamon stick
4 cardamom pods, bruised
1 teaspoon cumin seeds

1 teaspoon turmeric
1½ cups (235 g) shelled garden peas
3¼ cups (875 ml) hot chicken stock
1 teaspoon salt flakes
1 cup (155 g) raw cashews

METHOD

Wash the rice several times and drain well.

Heat the oil in a large sturdy pot, add the cloves, cinnamon, cardamom pods and cumin seeds and gently fry for 1 minute. Add the turmeric and rice and stir over medium heat for about 3 minutes. Add the peas with the hot stock and salt. Bring quickly to the boil, then turn the heat to very low and cover the pot with a tight fitting lid.

Cook for 25 minutes without lifting the lid. Remove the pot from the heat, take the lid off and stand for 3 minutes to let the stream escape. Remove whole spices at this stage if liked. Add the cashews and fluff the grains lightly with a fork and serve.

NUTRITION

Per serve 1350kJ/323 calories; 8.9g protein; 17g fat (includes 3g saturated fat; saturated : unsaturated fat ratio 0.2); 31g available carbohydrate (includes 3.5g sugars and 27g starch); 6g fibre; 434mg sodium; 284mg potassium; sodium : potassium ratio 1.5

RECIPE

Kate McGhie, *The Good Carbs Cookbook*, Murdoch Books.

IMAGE

Alan Benson

RAINBOW STEAMED RICE

1:00–2:00 hr Prep • 0:35 Cook • 4 Servings • Gluten free • Lactose free • Nut free • Main meal

INGREDIENTS
1 cup White rice
2 tablespoons Black rice
¼ Cup Red mung/Azuki beans
1 tablespoon Green mung beans
2 tablespoons Pearl barley
2 tablespoons Red quinoa
¼ Cup Sorghum
Roasted black sesame seeds, to sprinkle

METHOD
Preparation
Soak the black rice, sorghum, red beans and green mung beans separately for 1-2 hours or overnight. Drain the water.

Cooking
Put black rice, sorghums, red mung beans, green mung beans, pearl barley and red quinoa in a rice cooker. Do not mix them. Add 2 cups water or according to the rice cooker's instruction for 2 cups of rice. Choose the function for rice cooking. The time to cook varies depending on the cooker and may take ~35 minutes. When cooked, use the plastic rice spoon to mix all together. Sprinkle black sesame seeds on the top.

Serve with stir-fries or salads.

TIPS

- Try plant-based meat for extra protein. Pre-cook the plant-based meat and mix with the rice in the pan for 1-2 minutes.
- For quick and easy meal, can use tin or pre-cooked beans and grains instead raw rice and grains.

DID YOU KNOW?

This type of rice is popular in Asia. It is very similar to the traditional Korean multigrain rice (Japgokbap/Ogokbap) which also include grains and beans.

NUTRITION

Per serve 1528 kJ/365 calories; 12.5g protein; 2.5g fat (includes 0.7g saturated fat; saturated: unsaturated fat ratio 0.7); 69g available carbohydrate; 6.7g fibre; 7mg sodium; 400mg potassium; sodium: potassium ratio 0.02

RECIPE

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