Concepts to redress the nutritional balance: nutrient-dense foods for optimal nutrition

Executive summary

With changing lifestyles, an aging population and the need for reduced calorie intake to combat increasing levels of obesity, there is an opportunity for the food industry to develop products and services that enable consumers to choose appealing and affordable diets. There is also an opening to make market offerings healthier through nutrient fortification, which can be achieved using both food and dietary supplements. Although there are varying guidelines and reference values to plan and assess nutrient intakes, these differ between countries and focus on sugar and fat content, so far neglecting the nutritional content of food. This has highlighted the need for a consistent approach to nutrient profiling in order to produce comparable and logical labeling of all foods, as well as encourage consumer awareness of nutrient-energy density.

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The need for a nutrient-balance concept

Globally, life expectancy is increasing and in many developed regions of the world, this means a rapid aging of the population. It is expected that the proportion of the world's population over 60 years will reach 22% by the year 2050.[1] However, later years are often connected to worsening health. This is one of the reasons why non-communicable diseases (NCDs), such as osteoporosis and cardiovascular diseases are on the rise.

Moreover, there is substantial scientific evidence to link different lifestyle factors, including high consumption of energy-dense/nutrient-poor foods, to obesity and conditions like diabetes and cardiovascular disease (CVD). The number of people globally with diabetes has nearly quadrupled since 1980,[2] China reports the highest levels with 11.6% of people affected.[3] These NCDs not only detrimentally affect individual health and wellbeing, but their higher prevalence and chronic nature place a heavy economic burden on society and health care costs. There is therefore a need to raise awareness of and rebalance the nutrient-energy density within food products.

In addition, the combination of today's more sedentary lifestyles and the often appealing flavors of processed foods means that caloric intake needs to be reduced, in order to redress the energy balance and help combat the continuous increase in the global prevalence of obesity. Good taste, availability and affordability of energy-dense/nutrient-poor food items, alongside low satiating power, may be the main reasons for overeating and consequent weight gain.

What is nutrient-energy density?

Nutrient-energy density is the amount of nutrients per gram of food, in comparison to the calories it contains. Lower nutrient dense foods provide fewer nutrients but a higher number of calories, for example crisps, biscuits and cakes. Foods with a high nutrient-energy density contain more nutrients and less calories, for example vegetables and fruits.

Figure 1: Poor diet is the biggest risk factor for NCDs

The prevalence of NCDs is rising. They are projected to result in almost 75% more deaths than communicable, maternal and perinatal diseases by 2020 and to become the most common causes of death by 2030.

OBESITY

The worldwide rate of obesity has nearly doubled since 1980, with 200 million adult men and 300 million adult women now being classified as obese. By 2025, one-fifth of adults will fall into this category[4]

OSTEOPOROSIS

Worldwide, osteoporosis causes more than 8.9 million fractures every year[5]

DIABETES

The global prevalence of diabetes among adults has risen from 4.7% in 1980 to 8.5% in 2014. The WHO projects that diabetes will be the seventh most common cause of death in 2030[4]

CARDIOVASCULAR DISEASE

An estimated 17.5 million people currently die from CVDs each year, representing 31% of all global deaths[4]

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Currently consumers have to make food-related decisions with very little insight into the energy and nutrient composition of different food items. The result is that people generally consume too many calories and, at the same time, do not get the optimal amount of essential nutrients, such as vitamins, carotenoids, polyunsaturated long chain fatty acids, amino acids and minerals.

The majority of the world's population has inadequate intake and status of one or more of the essential vitamins and minerals. A third of people in developing countries are affected by vitamin and mineral deficiencies,[7,8] which can have a significant impact on healthy aging. According to the WHO, diabetes will be the seventh most common cause of death by 2030, while nearly a third of all global deaths are caused by CVD.

Figure 2: Consequences of imbalanced diets

COST TO SOCIETY:

$170 BILLION

Estimated cumulative healthcare costs of NCDs between 2011-2025[9]

There are currently guidelines and reference values to plan and assess nutrient intakes, called Dietary Reference Intakes (DRIs). DRIs are used by healthcare providers and government agencies to establish the guidelines for how much of each nutrient an individual needs.

The challenge is to understand better how nutrition modulates health and to identify, develop and implement solutions which promote a well-chosen diet for a healthy life. Although there are currently plenty of food choices available, the issue of calorie over-consumption needs to be addressed by a broader concept to support the introduction of products with an adequate macro- and micronutrient balance.

Nutrient-energy density refers to the content of micronutrients relative to energy in the diet. Information about nutrient-energy density can help identify foods that have a low energy to nutrient ratio and thus to compile diets that address nutritional shortfalls, without increasing the risk of obesity. This provides opportunities for the development of products and services which enable people to choose appealing, affordable diets and, in combination with physical activity, ensure optimal health throughout life.

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Inadequate nutrient intake is a global topic and is seen as the greatest challenge in the 21st century worldwide. More than 60% of healthcare costs and disabilities are due to lifestyle-related diseases.[10] In addition, consumers are increasingly demanding healthier food choices, with 90% of shoppers willing to pay more for the added quality and benefits of these options.[11] These are not just issues for industrialized countries like the US, Europe and Japan, but are also prevalent in India, China and the rest of the world.

Studies indicate that those who choose a diet rich in essential nutrients, characterized by an intake of vegetables, fruits, legumes, olive oil and fish, have a reduced risk of non-communicable diseases.[12] A balanced diet providing all essential nutrients, combined with adequate amounts of protein, carbohydrates and fats, is the basis for improved physical and intellectual performance.

To help improve health and development, the food industry and other relevant organizations need to define food quality and quantity. The potential influence of national nutrition policies could help the food industry to achieve this if it works in partnership. Eradicating deficiencies and improving nutritional status makes people healthier and, in turn, better able to contribute to their own development. In particular, it can ensure the proper mental and physical development of children, who then grow up to become productive members of the community. It also reduces the burden of healthcare costs and has an impact on the economic development of a country.[13]

Micronutrients are essential to human health, and are involved in many fundamental metabolic processes that the body cannot produce itself. Shortfalls in micronutrient intake can result in adverse health outcomes, for example:

- ***Vitamin D:*** *Severe vitamin D deficiency will result in bone brittleness. Insufficient vitamin D status has been associated with osteoporosis, increased risk of falls resulting in fractures and muscle weakness especially in the elderly. Prolonged vitamin D deficiency in children will induce rickets.*
- ***Vitamin C:*** *Early symptoms of vitamin C deficiency include fatigue, lassitude, loss of appetite, drowsiness and insomnia, feeling rundown, irritability, low resistance to infections and petechiae (minor capillary bleeding). Severe vitamin C deficiency leads to scurvy, characterized by weakening of collagenous structures, resulting in widespread capillary bleeding.*
- ***Vitamin E:*** *Recent research has shown that people with metabolic syndrome need 30-50% more vitamin E. Symptoms of vitamin E deficiency are seen in patients with fat malabsorption syndromes or liver disease and in individuals with genetic defects affecting the a-tocopherol transfer protein. Vitamin E deficiency results in neurological symptoms.*
- ***EPA and DHA omega-3 fatty acids:*** *EPA and DHA deficiency refers to low or insufficient levels of important long-chain fatty acids, as these are required to regulate cardiovascular, immune and inflammatory pathways. Symptoms of omega-3 fatty acid deficiency include fatigue, poor memory, dry skin, heart problems, mood swings or depression, and poor circulation.*
- ***Iron:*** *Iron deficiency is the most common and widespread nutritional disorder in the world. The major health consequences include poor pregnancy outcome, impaired physical and cognitive development, increased risk of morbidity in children and reduced work productivity in adults.*
- ***Folic acid:*** *Early symptoms of folate deficiency may include tiredness, irritability and loss of appetite. Severe deficiency leads to megaloblastic anemia. It has been demonstrated that periconceptional supplementation of women with folic acid can decrease the risk of neural tube defects. Deficiency during pregnancy may result in premature birth, infant low birth weight and fetal growth retardation.*

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Food fortification and dietary supplements are key

Micronutrients are obtained in small amounts from the diet and do not provide calories or energy. In fact, they help convert food into energy and are essential for maintaining good health, such as immune function, bone health and metabolism.

Dietary guidelines still insist that all nutrients come from foods and there was a time when eating more food meant consuming more nutrients. This relationship no longer exists due to the low cost of empty calories. It is now possible to be undernourished, yet overfed.

Sources of micronutrients include conventional foods, fortified foods, bio-fortification, and vitamin and mineral supplements. Over the last few decades, the consumption of nutrient-rich conventional foods, for example wholegrains, vegetables, and low-fat dairy products, has partially shifted to the consumption of nutrient-poor foods which are, at the same time, energy-dense. This change in food consumption patterns could be seen as an important factor when considering the reasons behind insufficient dietary intakes of micronutrients.

Widespread nutrient intake shortfalls and the associated deficiencies can be prevented or improved not only by means of nutritional advice on consumption patterns, but also by using fortified foods and dietary supplements. Fortification can counteract insufficient nutrient intake and is a key approach to achieving adequate micronutrient intake. It has the potential to rapidly improve the micronutrient status of the population and requires no changes in existing food patterns or in individual compliance.

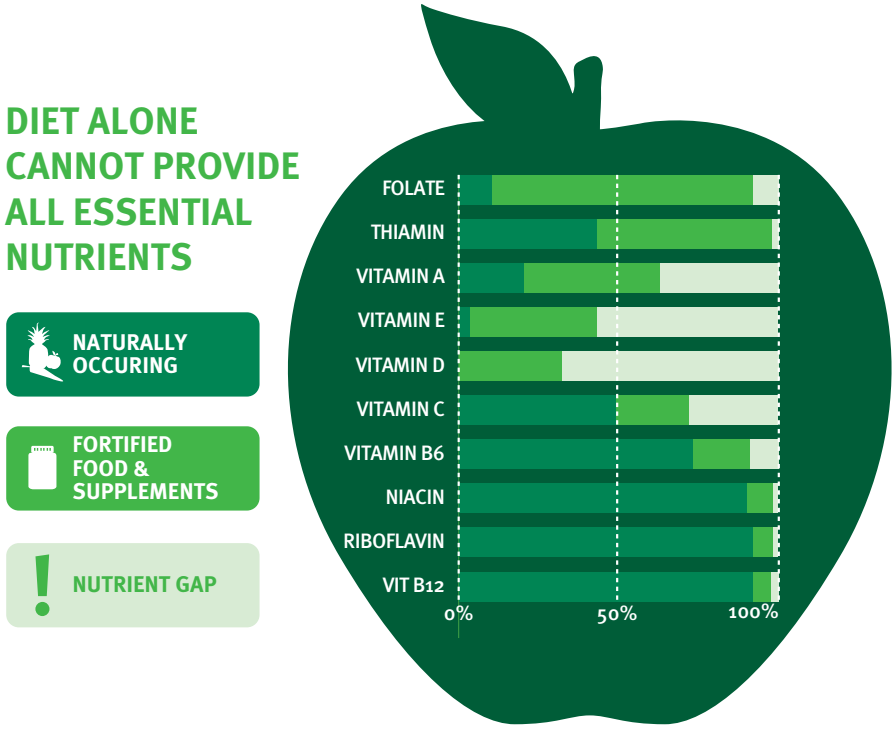

Figure 3

Analysis aimed to assess contributions of micronutrients to usual intakes derived from naturally occurring sources, fortified and enriched foods, and dietary supplements, and to compare usual intakes to the Dietary Reference Intake for US residents aged ≥2 years according to NHANES 2003–2006[14]

Fortification can help create foods that are good tasting, affordable, accessible, acceptable and nutrient-rich. It has been shown to be one of the safest and most cost-effective measures to improve the nutritional value of a diet. More and more staple food producers are recognizing that fortifying their products voluntarily can add value and give them a competitive edge. Through fortification, they are also actively contributing to sustainable public health improvement and bringing long-term benefits to communities.

Different types of food fortification:

- ***Conventional fortification:*** *staple foods, dairy, spreads and condiments*
- ***Supplementation:*** *tablets and powders*
- ***Bio-fortification:*** *agricultural products, such as rice and maize*

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Nutrient profiling helps improve the nutritional value of foods

Regulatory bodies and the food industry have started to engage with the concept of nutrient-energy density, responding to the shift in consumer desire for more nutritious foods rather than those with reduced calories. Although many food product labels now use systems to show the levels of calories, fats, sugar and salt, they do not take nutrients into account.

A nutrient-dense food is one that provides a proportion of key nutrients relative to its energy content. This is often defined as nutrient intake (g or mg) per 100g or 100kcal, or Reference Amount Customarily Consumed (RACC). Each calculation favors different foods classified as healthy; for example, using per 100kcal tends to favor low-energy dense vegetables and salad greens. Using per 100g tends to favor energy-dense foods, such as nuts and seeds.

A nutrient-density score should help to make a healthy diet more achievable for everybody. Micronutrients related to energy can help enhance food quality and reduce energy intake to improve micronutrient intake and general health. Cost-effective micronutrients can make nutritious foods more readily available, helping to guide the consumer to improve their diet.

The goal of most nutrient profiling systems is to distinguish foods that are energy-dense from those that are nutrient-rich. By focusing almost exclusively on individual foods, the work on nutrient profiling has yielded some paradoxes. Some low-ranked foods considered to be detrimental to health in fact contain specific nutrients indispensable to good health. On the other hand, some of the highly-ranked nutrient-rich foods do not contain sufficient calories to meet energy requirements. Also missing from most nutrient profiling models are broader considerations of how nearly all foods can play a role in improving nutrition quality in meals and diets.

As nutrient profiling is rapidly becoming the basis for regulating nutrition labels, health claims and marketing activities, a number of models and scoring systems have been developed by researchers, regulatory agencies and the food industry. Some of these tools have focused on nutrients to limit, others have emphasized nutrients with health benefits, and some combine both. Their preparation should cover the selection of index nutrients and reference amounts, the development of an appropriate algorithm for calculating nutrient-energy density, and the validation of the chosen nutrient profile model against healthy diets.

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Examples of nutrient profiling models

Netherlands

In the Netherlands, the Government has introduced a qualifier/health logo for basic food groups and another for non-basic food groups as part of an approach for the assessment of consumer products. This is conducted by independent experts from different disciplines, including food technology, public health nutrition, legislation and consumer science. However, it currently only evaluates sugar, fat, salt and energy content versus guidelines. Data on the food's composition and its nutrient profile is required for an adequate assessment.

The health logos already have high awareness with consumers and have resulted in many product reformulations for healthier offerings. However, there is an ongoing debate about implementing a traffic light system as the two health logos are not completely understood.

www.government.nl/topics/food

India

India's recently introduced 'fortified' logo will appear on the packaging of staple products to indicate those which have been fortified with added vitamins and minerals. The blue square of the logo sits easily alongside the green square of the vegetarian symbol and the red square of the non-vegetarian symbol, to ensure ease of understanding among consumers.

www.ffrc.fssai.gov.in

Philippines

The Sangkap Pinoy Seal Program (SPSP) encourages food manufacturers to fortify processed foods or food products with low levels of naturally-occurring essential nutrients. Consumers recognize the SPSP logo and use it as guidance to select nutritious and fortified foods.

doh.gov.ph/food-fortification-program

USA

In the USA, the implementation of a Nutrition Facts Panel reflects a first step towards providing the consumer with energy-nutrient information and will be effective from July 2018. This involves new food labels that include both nutrient content and calorie content.

www.fda.gov/food/guidanceregulation

South Africa

By law, any person who manufactures, imports, or sells bread wheat flour and maize meal must fortify them with a number of vitamins and minerals. All shelved goods are required to be properly labeled in accordance with the Regulations Relating to the Fortification of Certain Foodstuffs. This includes the fortification logo, which must be displayed alongside a nutrition declaration table. The aim is to inform consumers about the nutritional value of foods.

www.health.gov.za

New Zealand

The Health Star Rating system is a voluntary front-of-pack labeling system that enables New Zealand consumers to make better informed and healthier food choices more quickly and easily. It uses a rating scale of half a star to five stars and foods with more stars have better nutritional value. The system also includes nutrient information icons for energy (kilojoules), saturated fat, sodium (salt) and sugars, and can include one beneficial nutrient such as calcium or fiber. Research with New Zealand consumers in 2013 showed that the Health Star Rating system helps them to identify healthier foods when faced with a choice.

www.foodsafety.govt.nz

Singapore

Singapore's Healthier Choice Symbol Program (HCS) is intended to guide purchases in a way that incorporates healthier options into the diet. Products with the symbol are generally lower in fat, saturated fat, sodium and sugar, and higher in dietary fiber, calcium and wholegrains. To make nutrition labeling more comprehensive, the Health Promotion Board is introducing enhanced versions of the HCS, each of which focuses on a particular nutritional aspect of the product.

www.hpb.gov.sg

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How nutrient-energy density translates into healthier dietary routines

Nutrient-energy density scores can help identify affordable high quality foods and are useful for communicating to the public, helping make a healthy diet more achievable for everyone. There are different types of nutrient-energy density scores already available, but these have not yet been implemented.

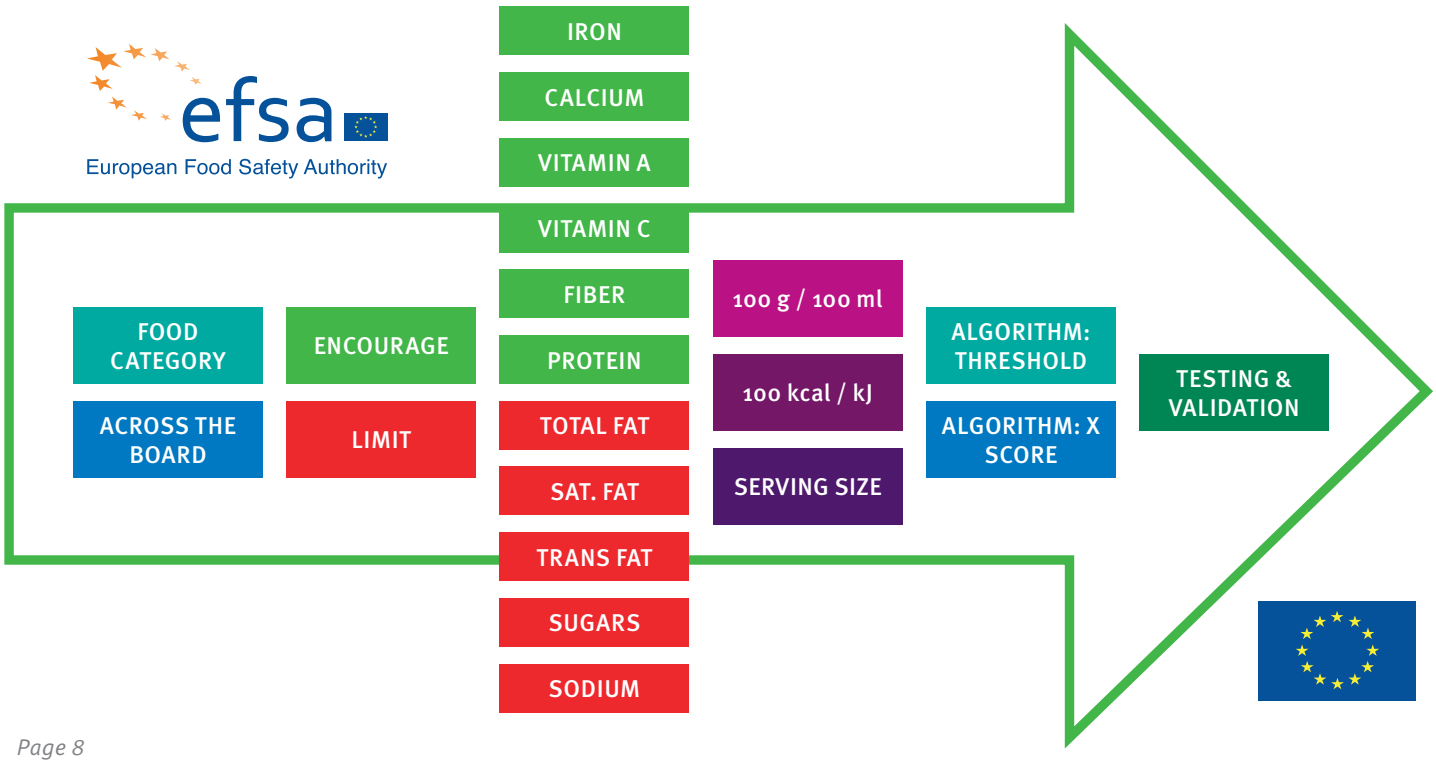
- Nutritional quality index (NQI): The amount of a particular nutrient in food (based on the consumption of 2,000kcal) relative to the food's energy content. This is a nutrient-by-nutrient approach and does not calculate the overall nutritional quality of food.
- Calories for nutrient score (CFN): Percentage of the mean daily value (13 MN) related to energy density (% DV) of 100g of food. The lower the CFN, the lower the calories to obtain the nutrients with a given food.
- Naturally nutrient rich score (NNR): Similar to NQI, but based on mean percentage of DV of 14 MN.

A powerful tool is needed to help consumers to make the right choices for their diets and identify foods rich in essential nutrients. Nutrient-energy density provides the basis for this message by relating micronutrient content to energy content.

A new nutrient energy-density score concept is the nutrient-rich food index (NRF 9.3), which may be the best fit to guide consumers. It is a comprehensive food guidance system that can be applied to food groups, meals, menus and total diets. The aim is to help consumers get more nutrients from the calories they consume and promote healthier diets. It is to also provide a uniform benchmark for mandatory or self-regulation by industry and encourage the production and marketing of more nutrient-dense foods. Each food is assigned a unitary science-based score that best reflects its nutrient quality and is based on the USDA's 2005 Healthy Eating Index (HEI), an objective measure of a healthy diet. It can be used as a nutritional navigation system for both food producers and consumers, helping to optimize products and diets.

The NRF 9.3 is a scientifically valid definition of nutrient-energy density and is based on nine nutrients to encourage and three nutrients to limit. It is created with open-source, transparent databases and based on established and authoritative sources. It uses the 100kcal basis and "unweighted" scores and is capped to nutrient contributions of 100% DV. Regulatory agencies, such as the European Food Safety Authority (EFSA), also recommend the same science-driven process.

Figure 4: EFSA recommendations for a science-driven food labelling process



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Consumption of nutrient-dense foods associated with lower energy intakes results in a higher quality of diet and improved health outcomes. However, it is difficult to achieve adequate nutrition recommendations without excess energy intake. Providing guidelines is not good enough, practical and achievable nutritional solutions are needed.

Translating the concept of nutrient-energy density into healthier everyday dietary habits requires the use of nutrient profiling methods combined with other strategies. For example, the science-driven development of an existing nutrient-energy density score (NRF) to rate current or future food products based on their nutrient and energy profile, or the development of a food and nutrition map as a tool to translate and transfer nutritional information in a way that is both useful and valuable to the consumer.

Conclusion

The joining of academia, regulatory bodies, consumer organizations and industry partners to develop and agree on an optimized nutrient-energy density approach, as well as initiating a developmental process and its implementation will play a significant role in bringing change. Developing a storyline to relate nutrient-energy density to the risk of obesity and NCDs will also help, as well as selecting a nutrient-energy density score to evolve with a view to developing communication, advocacy and educational tools with experts. Food producers can market their products as part of a sustainability policy, alongside positioning micronutrients as part of its social responsibility.

Key take-away messages

- Insufficient micronutrient intake can lead to NCDs and other health issues
- Dietary supplements and fortified foods can help, but there is a need for a nutrient-balance concept
- Assessment of dietary intakes varies by country, but none take nutrient-density into account
- Nutrient profiling can help to bridge this gap
- A multi-stakeholder approach is needed with a governmental body in the lead, as well as nutrient profiling by expert groups and a consultation process
- Educating consumers will be key to ensuring a holistic approach, and a number of different tactics should be considered, for example nutritional surveys, educational events and school programs
- Consistent and logical labeling of all foods is required
- This will lead to consumer acceptance and appropriate product positioning, increasing healthier market offerings and enabling consumers to choose appealing and affordable diets

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