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The issue of acidity and alkalinity in our diet – Facts, popular beliefs, and the reality

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ABSTRACT

Several misconceptions exist about foods and nutrition. Many believe, that the human body can "acidify", thus, an "alkaline diet" should be followed. The acid-base balance is a characteristic of a normally functioning human body. Throughout our metabolic processes, acids and substances with acidic pH are produced continuously, which, in the case of a healthy person, does not affect the pH of the human body. In those rare cases, when an overall pH imbalance evolves in the human body due to its life-threatening nature, it requires urgent medical intervention. Furthermore, it cannot be influenced by dietary interventions.

This paper highlights evidence regarding acidification and the acid-base balance, with special attention to certain food groups. Foodstuffs have different specific pH value (acid-base character), they can be acidic, alkaline, or neutral in elemental state. Beside their chemical nature, the effect they have on the human body depends on the mechanism of their metabolism, as well. Diet and ingredients have direct and indirect effects on the human body's intracellular and extracellular compartments (especially blood and urine), still they do not influence its pH significantly.

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Alkaline diets were born in the absence of evidence-based information and/or the misunderstanding and wrong interpretation of the available and up-to-date scientific facts. The convictions of consumers and the promotion of the alkaline diet lack the scientific basis, so it can be harmful or even dangerous in the long run.

In summary, scientific evidence on the efficacy or prophylactic effects of an alkaline diet is not available.

KEYWORDS

alkalinisation, alkaline diet, food, pH, acid-base balance

1. INTRODUCTION

Nutrition is an integral part of our everyday life. We feed our body with macro- and micro-nutrients, as well as with anti-nutritional compounds. It is essential that our diet contains the proper quantity and quality of all those nutrients that are necessary for the maintenance of the body's physiological processes. A balanced and healthy diet contains a good variety of certain foods in appropriate quantities (Lonnie et al., 2018).

Under certain conditions and given circumstances, the metabolites of carbohydrates can induce the development of acidosis. During the aerobic and anaerobic breakdown of carbohydrates and glucose, pyruvic acid evolves, which is only an intermediary metabolite. Since the breakdown happens intracellularly, it cannot „acidify" the organism. During oxidation, carbon dioxide is produced, but beside the regulation of the buffer system, it leaves the body. However, the anaerobic reduction of the pyruvic acid leads to the development of lactic acid. Lactic acid can have a negative effect on some tissues (e.g. muscle soreness), but with the improvement of oxygen supplies, it becomes resolved and the lactic acid is metabolised in the liver, and in some cases it is excerted through the kidney. Lactic acidosis, affecting the whole body, can concern patients with hepatic failure and it can be a side affect of certain medications (oral antidiabetics) (Baynes and Dominiczak, 2018). Dietary alkalinisation does not have any benefits in either of the above-mentioned conditions and medical treatment is necessary (Boron and Boulpaep, 2017).

The digestion of fats results in free fatty acids, however, they have low solubility in blood and they are present in low quantities, so they do not have any influence on the pH of the blood. Carbon dioxide also evolves as a byproduct of fatty acid breakdown and leaves the body through the lungs. If the metabolism is shifted in the body and it receives energy appreciably from the use and breakdown of fats, via lipolysis, ketoacidosis can evolve. It can originate from the utilisation failure of carbohydrates (lack of insulin) or the absolute lack of carbohydrates, in the case of certain disorders of the carbohydrate metabolism (e.g. diabetes), or during prolonged fasting and starvation. During the production of energy, specifically from the degradation of fat, a lack of fatty acid transfer molecules (typically CoA) can develop and it persuades the body to metabolic pathways, which induces the production of ketone bodies (Boron and Boulpaep, 2017). In the state of ketosis, acetone, acetoacetic acid, and β-hydroxy β-methylbutyric acid can be created, which get breaked down and then leave the body with urine or by breathing (acetone breath). Acidosis cannot be triggered by either ketone bodies or increased fat consumption individually,

without other abnormal/pathological and extreme physiological conditions or disease (McPhee et al., 2019).

Although increased fat consumption does not lead to acute acid-base crisis in the body, it counts as a significant risk factor in the development of cardiovascular diseases and certain chronic diseases (McPhee et al., 2019). Compared to a balanced diet, increased or intentionally exceeded fat consumption is not recommended in any form for a healthy person (Kinoshita et al., 2018).

Appropriate intake of proteins is essential for the maintenance of tissues, as well as the growth and development of the body. Muscles, bones, cartilages, skin, blood, and lymph contain proteins. Amino acids are components of hormones, enzymes, immunoglobulines and can be molecular precursors of components of RNA. They play an important role in the structure of compounds (tryptophan, histidine), which are necessary for metabolic processes. During the degradation of amino groups of proteins, urea can be produced, which is used as an ammonium buffer until the carboxyl-group is fully utilised, so it does not have a vital effect on the acid-base balance. However, the degradation of certain side-chains seems more heterogeneous, as during their degradation, several substances are created with different pH values. In the case of neutral amino acids (serine, alanine), there is no acid production (Baynes and Dominiczak, 2018).

Through the oxidation of neutral amino acids containing sulphur (cysteine, cystine, and methionine), sulphuric acid can be produced. Hydrochloric acid is formed as a product of the breakdown of cationic amino acids (arginine, lysine, and histidine). The latter two metabolites are present in the body in very small quantities and are neutralised within a short time by buffer systems, so there is no significant risk of acidification. In the case of anionic amino acids (aspartic acid, glutamic acid), alkaline metabolites are formed. The degradation of proteins in the body, therefore, has no significant acidifying or alkalinising effect (Boron and Boulpaep, 2017).

The metabolic product of the breakdown of phosphoproteins and phosphodiesters is phosphoric acid, which also acts as a phosphate buffer in the body. When discussing proteins, we should mention the uric acid, which stands in the centre of many descriptions regarding “alkalinisation” and that of the alkaline diets. Uric acid is one of the most well-known purine derivative compounds, which can be found in the urine of both humans and other mammals, since the human body is not capable of breaking it down, it is eliminated through excretion (McPhee et al., 2019). In the case of high uric acid level, it can be necessary to moderate the intake of meat products, offals, and animal protein sources (because of their high purine content), furthermore a low-fat, temporary diet, consisting of small portions, helps in the normalisation of the body weight and the prevention of arthritis. It is obvious, that the high uric acid level cannot be linked to the “acidification” of the body either, rather to the development of arthritis and other metabolic diseases (Antia and Abraham, 1998).

2. THE ACID-BASE BALANCE REGULATION IN THE HUMAN BODY

2.1. Basic physiological aspects

Buffers basically provide a constant pH value and it is not different in our body either. One of the main buffers of the body is blood, which receives the largest buffer capacity from the red blood cells (haemoglobin). Apart from blood, plasma proteins have further significant buffering

abilities (Baynes and Dominiczak, 2018). We should mention the volatile and non-volatile acidic components of the carbonic acid/bicarbonate system, which leave the body through the lungs and excretion, in this way these two organs (lungs, kidneys) have the most important role in sustaining the acid-base balance (Antia and Abraham, 1998).

The acid-base balance has an important role in the functioning of the human body, in several physiological processes: in the organism as bone formation, the pH sensitivity of enzymes, and in oxygen binding, too. The vital processes can only take place in the narrow range of the optimal pH-value (in the case of certain organ systems and extracellular fluid (ECF) spaces, varied pH values can be considered natural, which is demonstrated by Table 1).

During the metabolic processes, acids and acidic substances are continuously produced, which does not influence the "body's pH" in the case of a healthy person, as the body's buffer systems regulate these processes. Certain body fluids (lymph, blood, urine, and gastric acid) have a determined pH, and in the case of their imbalance, we can talk about pathological conditions, which have typical attendant symptoms (acute cases: acidosis, alkalosis) (Remer, 2001a). Therefore, a persistent and severe acid-base imbalance affecting the whole body should not develop, or if it does, it requires urgent medical intervention because of its life-threatening nature. However, it cannot be controlled via diet (Vormann and Remer, 2008; Schwalfenberg, 2012).

3. THE ACID-BASE CHARACTER AND THE EFFECT OF FOODSTUFFS ON HUMAN EXCRETION

Although the acid-base balance of the body cannot be influenced through diet, certain raw foods and foodstuffs have specific pH values (acid-base character), based on which they can be acidic, alkaline, and neutral in their elemental state (Table 2). This identification takes place with dissolution, following the incineration of dietary substances. The effects of certain foodstuffs in the body depend to a large extent, beside their chemical nature, on the mechanisms they are digested and absorbed by (Remer, 2001a).

Diets and ingredients have direct and indirect effects on the acid-base balance in the human body's intracellular and extracellular compartments (especially blood and urine), but do not

Table 1. pH values of body fluids and liquids (Boron and Boulpaep, 2017)

Organ, liquid, or membrane	Natural pH	pH function
Skin	4–6.5	Protection against the microbes
Urine	4.6–8.0	Restricts the overgrowth of microbes
Gastric	1.35–3.5	Required for protein degradation
Bile	7.6–8.8	Neutralises stomach acid, aids digestion
Pancreatic fluid	8.8	Neutralises stomach acid, aids digestion
Vaginal fluid	<4.7	Restricts the overgrowth of microbes
Cerebrospinal fluid	7.3	Provides protection
Intracellular fluid	6.0–7.2	According to the acid production of the cells
Blood serum (venous)	7.35	Tightly regulated
Blood serum (arterial)	7.45	Tightly regulated

Table 2. The specific pH value of foodstuffs in elemental state (FDA/Center for Food Safety & Applied Nutrition, 2008)

Acidic character (pH: 0–6.9)	Neutral chemical composition (pH: 7)	Alkaline character (pH: 7.1–14)
Cereals: barley, oatmeal, white rice, refined pasta and wheat bread	Water	Milk and other milk products (sour cream, cheese)
Egg and egg yolk (products from this origin: mayonaisse)	Corn starch	Chestnuts, almond
Meat (pork, beef, poultry, pisces)	Animal origin fat (lard, butter)	Some fruits and juices (e.g. blackcurrant, peach, strawberry, apple, grape, pineapple, pear)
Peanuts, walnut	Plant origin fats and oils (margarine, vegetable oils)	Most of vegetables (e.g. lettuce, carrot, beetroot, potatoes, celery, tomatoes, cauliflower)
Dried legumes (white bean, soybean, lentil, bean, pea, chickpea)	Sugar and sweets	Jam

influence it significantly. The ingredients of meals, the proportion of the absorption of the main nutrients, the quality of amino acids, the level of the sulphate dissociation in the physiological pH value of 7.4, and the calcium and magnesium ions are all important factors. The PRAL (potential renal acid load) of the diet and meals can be estimated with the help of these factors. PRAL (24 h) is a relative constant that gives the total daily acid secretion as a result, together with the amount of organic acid in the urine (Remer, 2001b).

Based on PRAL, we can group raw foods into positive and negative acidity load categories, typically based on their alkaline salt content and phosphate content (Vormann and Remer, 2008).

Fruits, vegetables, potato, juices made from them, and drinks with low phosphate-content (white and red wine, mineral water) belong to the negative, while seeds, cereals, meats, dairies, fish, light beer, cocoa, and soft drinks belong to the positive acidity load category (Table 3) (Remer and Manz, 1995; Welch et al., 2008).

Taking all these factors into account (based on the PRAL value), alkaline diets cannot be considered balanced and sustainable in the long run. It can raise the insufficiency of the intake of proteins with large biological value and essential fatty acids, the intake of complex carbohydrates in small amounts and simple sugars in large amounts, not to mention the consumption of alcoholic drinks and coffee (Remer, 2001b; Schwalfenberg, 2012; Fenton et al., 2017).

4. BELIEFS AND EVIDENCES REGARDING THE MOST IMPORTANT FOOD GROUPS

4.1. Vegetables

"Vegetables should have a central role in our diets, every meal should mainly consist of them." (Young and Young, 2006). There is no problem with this statement, since in a balanced and varied diet multiple vegetable consumption per day is recommended. However, this statement of

Table 3. Potential renal acid loads (PRALs) of foods (Remer, 2001a; Schwalfenberg, 2012)

Food or food group	PRAL MEQ: $Cl+PO_4+SO_4-Na-K-Ca-Mg$
Dairy products	
Parmesan cheese	34.2
Processed cheese plain	28.7
Cheddar reduced fat	26.4
Hard cheese (average)	19.2
Fresh cheese (quark)	11.3
Cottage cheese plain	8.7
Yogurt whole milk	1.5
Ice cream	0.8
Whole milk	0.7
Buttermilk	0.5
Eggs	
Eggs yolk	23.4
Eggs white	1.1
Eggs chicken whole	8.2
Meats	
Corned beef	13.2
Luncheon meat canned	10.2
Turkey	9.9
Veal	9.0
Lean beef	7.8
Frankfurters	6.7
Vegetables	
Cucumber	−0.8
Broccoli	−1.2
Tomato	−3.1
Eggplant	−3.4
Celery	−5.2
Spinach	−14.0
Fats and oils	
Butter	0.6
Margarine	−0.5
Olive oil	0.0
Fruits and nuts and fruit juices	
Peanuts	8.3
Walnuts	6.8
Grape juice unsweetened	−1.0
Orange juice unsweetened	−2.9
Apples or apple juice unsweetened	−2.2
Apricots	−4.8
Banana	−5.5
Black currents	−6.5
Raisins	−21.0
Grains and grain products	
Brown rice	12.5

(continued)

Table 3. Continued

Food or food group	PRAL MEQ: $Cl+PO_4+SO_4-Na-K-Ca-Mg$
Rolled oats	10.7
Spaghetti whole meal	7.3
Spaghetti white	6.5
Cornflakes	6.0
Rice white	4.6
Bread rye flower	4.1
Bread whole wheat	1.8
Legumes	
Lentils green and brown	3.5
Green beans	−3.1
Fish	
Trout brown	10.8
Cod fillets	7.1

Young is not based on the significant vitamin, mineral, and fibre contents of vegetables, as identified by the WHO, but on the alkaline salts and chlorophyll contents, though their effect on the human body has not been proven by scientific evidence (WHO, 2013).

The supporters and promoters of the alkaline diet recommend the consumption of raw and mild processed vegetables, which fundamentally does not contradict the principles of healthy diets. However, in order to prevent food-borne diseases caused by pathogens and contamination, proper cleaning of raw foods should be emphasised. High fibre content can lead to bloating amongst people being sensitive to them, which has to be considered as well. Vegetables with higher carbohydrate content (e.g. potato) fall under total prohibition in the so-called alkaline diet (Young and Young, 2006), which is quite radical in the sense of diets, it can narrow the possible food sources down significantly (their increased consumption can have negative effects, but in a balanced diet, they do have their role) (Hanley and Whiting, 2013; Fenton and Fenton, 2016).

4.2. Dried legumes

Dried legumes (e.g. beans, lentils, soybeans) are recommended for consumption periodically, because prolonged storage and preservation is not accepted by the followers of this diet. This group of raw foods can be a really important part of the alkaline diet because of their high protein content, as it is the only measurable protein source (because of the strongly limited amounts of animal proteins with high biological value) (Young and Young, 2006). Bloating can also be an obstructive factor, not to mention a potential soy allergy, and the fact, that covering 90–100% of the total intake of a macronutrient is not a feature of the varied diet at all (Messina, 2014; Szűcs, 2016).

4.3. Mushrooms

Edible mushrooms are forbidden in the alkaline diet, their conviction is that the edible variants are toxic as well as the poisonous ones (statement without evidence) (Young and Young, 2006).

In fact, this claim influences only the diversity, it does not pose a significant nutritional risk (Szűcs, 2016).

4.4. Fruits

Fruits, beside wholegrain cereals and vegetables, provide the basis of a balanced and varied diet, their daily consumption is recommended, as their vitamin and mineral content contributes significantly to the appropriate functioning of the human body (Szűcs, 2016; Angelino et al., 2019). We can observe the largest conflict of the alkaline diet with the principles of a healthy diet, regarding this group of raw foods. Because of their high sugar (fructose) content, the alkaline diet indicates that the consumption of this group of raw foods should be avoided („acidifying the body") (Young and Young, 2006). However, the consumption of certain citrus fruits (lemon, lime, and grapefruit) is highly recommended, without any justification. In the long run, this dietary restriction can result in reduced vitamin and mineral levels; therefore, deficiency may derive; moreover, the risk of some chronic diseases can increase as well (cardiovascular diseases, tumour, diabetes, etc.) (Zhan et al., 2017; Hurtado-Barroso et al., 2020; Halvorsen et al., 2021).

4.5. Milk and dairy products

Milk and dairy products are likewise harmful to the body, according to the principles of the alkaline diet. Despite the fact, that the strict regulations related to processing and the composition of products are acknowledged, by Young's false opinion, milk, besides lactate, contains a critical amount of hormones and chemical residues, which pose an additional threat to our health. Regardless of this, he does not permit the use or mention milk that is produced by organic farming in his dietary suggestions, just like he does not mention the probiotic lactobacteria and fungal strains found in milk either (Young and Young, 2006). For the experts from the fields of food and nutrition sciences, the advantages of consuming fermented or acidified dairy products are obvious; however, the followers of the alkaline diet consider these something to avoid, as during their production fungi, bacteria, and noble mould strains are used, which are toxic according to their point of view, not to mention that these products contain lactic acid in a concentrated amount (Barrubés et al., 2019; Savaiano and Hutkins, 2020).

Despite the fact that acid loading or a protein-rich diet might be associated with an increase in calciuria, there is no exact evidence linking these factors to osteoporosis. Further, studies of alkaline diets and supplements have not shown benefits to bone health (Hanley and Whiting, 2013).

It is important to notice, that the intake of complete proteins, calcium, and vitamin D may be challenged (their replacement cannot be implemented either, because potential alternatives are banned as well), which can lead to the evolution of osteoporosis or other deficiencies (Szűcs, 2016; Park et al., 2018).

4.6. Meat, meat products, harslet, eggs

The following item on the list of banned foodstuffs is this group of raw foods, their consumption is not recommended, only in sparse quantities, because of the "acidification" of the body. Likewise described for dairy products, Young also refers to the presence of hormones, chemical

residues, and mycotoxins originating from the feedingstuffs (Young and Young, 2006). This view is professionally incomprehensible; cereals and grains that are used for feeding animals can contain mycotoxins in significant amounts (the indirect contamination originated from meat and milk products is far smaller); however, he does not forbid the consumption of the considered potential sources of mycotoxin contamination in his dietary suggestions (Young and Young, 2006; Matle et al., 2020).

As far as he is concerned, people, *who cover 70% of their protein intake by proteins of animal origin, suffer from serious health problems, compared to those, whose intake of animal proteins is only 5% of the total protein intake*, although, this statement is not justified (Young and Young, 2006). Furthermore, whole proteins, amino acids, valuable minerals, and vitamins found in meats, truly are important factors of a balanced and varied diet. The detailed restrictions of the so-called alkaline diet can lead to the deviation of states of deficiency and diseases, because of the absence of several minerals (e.g. iron) and vitamin B12. The authors do not intend to further discuss and evaluate the effects diets based on meat and meat products may have on health (Szűcs, 2016; Hovinen et al., 2021).

4.7. Fishes

Surprisingly, fish can be consumed occasionally in the alkaline diet. Meat, offal, egg, milk, dairy products are considered as being contaminated, however, natural waters can also contain several sources of chemical and microbiological contaminants. Despite this, Young believes, that fishes are resistant to such contamination. Interestingly, he would not consider heavy metal contaminations or the harmful effects of certain aquatic parasites. *The benefits of essential oils found in fish are far above the risk of mercury poisoning*, he states without a sufficient risk-benefit assessment (Young and Young, 2006). The allowance of fish consumption is positive from a nutrition point of view, because of their eicosapentaenoic acid (EPA), docosahexaenoic acid (DHA), and beneficial fatty acid (omega-3) contents. Despite his support to fish, he does not allow the consumption of marine molluscs, mussels, and algae (Szűcs, 2016; Djuricic and Calder, 2021; von Shacky, 2021).

4.8. Fats of animal origin

The alkaline diet forbids the use of fats of animal origin except fish oil (see Chapter 4.7). Young does not specify the use of animal fats, as he considers other animal products harmful as well, so it is evident, that he thinks fats are also dangerous (Young and Young, 2006). Because of the high saturated fatty acid content, the consumption of fats of animal origin has a high cardiovascular risk; on the other hand, in an appropriate amount, it can be part of a balanced and enjoyable, tasty diet (Szűcs, 2016; Bays et al., 2021).

4.9. Oilseeds, vegetable oils

The main recommendations of the alkaline diet are truly controversial. Hydrogenated and refined oils that are susceptible to rancidity and mould growth are completely ignored, while cold-pressed, virgin vegetable oils are recommended. Young acknowledges the positive effects of essential fatty acids, but in a rather "interesting" way, lacking evidence: "they lubricate the surface of joints", "they insulate the body" (Young and Young, 2006). These dietary suggestions are not fundamentally wrong, as they closely meet the official dietary recommendations

regarding their fatty acid compositions, but because of the restrictions, the fatty acid content of the alkaline diet can be a crucial question (Szűcs, 2016; Zhao et al., 2021).

5. RESULTS AND DISCUSSION

As a discussion, it can be stated that the acid-base balance has an important role in the functioning of the human body, but the diet is not capable of influencing the pH value of the whole body, or the body liquids inside the body, neither permanently nor significantly (Remer, 2001a; Boron and Boulpaep, 2017). Several factors influence the composition and quality of raw foods, thus those of meat and meat products, among others are species, breed, the origin, the quality of the soil, the production and processing technologies, the materials used (Dickinson, 2005). The unilateral, one-track alkaline diet, aiming to sustain the acid-base balance, may have a radical effect on the metabolism in the human body. A nutritional strategy aiming to substantially modify the metabolism would lead to chronic, metabolic, and deficiency diseases (Antia and Abraham, 1998; Szűcs, 2016).

The argumentation of the promoters of the alkaline diet is based on the belief that the ideal pH value of the body has to be maintained to allow the normal functioning of the body, because certain chronic diseases can be linked to the "acidification" of the body (it had been factually refuted above). In this sense, the followers/believers of this diet recommend increased consumption of raw foods and foodstuffs that are alkaline in accordance with their judgements. On the contrary, they forbid the consumption of certain foodstuffs and raw foods that are indispensable for a balanced diet (Young and Young, 2006). Fundamentally, the alkaline diet is built on false beliefs because of misinterpreted facts and information-bits, lack of evidence-based information, and/or the misunderstanding and misperception of available information, as it completely ignores the above-mentioned physiological principles. Table 4 presents the summary of the misconceptions and evidence-based scientific facts in the case of mentioned foodstuffs.

6. CONCLUSIONS

The main objective of the targeted dietotherapy is on one hand, to provide patients with a therapeutic diet, and on the other hand, to provide a group (e.g. athletes) with a special diet. Nowadays, in line with the "health-conscious" trends, extreme, one-sided, unilateral, and otherwise unbalanced diets with the aim of losing weight are quite widespread and are rather harmful than health-supportive due to the lack of appropriate information and science-based support. In general, certain dietary restrictions and guidelines can be included in a healthy diet, as long as there are no pathological changes, deficiencies, or diseases and the chosen way of nutrition does not collide in principle with the regulations of the balanced diet. It is a prerequisite of the appropriate diet that provides the body the proper quality and quantity of macro-and micronutrients without any health risk. The most important principle in nutrition is to follow a balanced and varied diet. It is important, that a nutrition therapy, built on scientific evidence, is necessary for meeting certain modified needs of the body, it has pre-determined steps that allow the setup of dietary suggestions based on the unique demands of the person (with the help of a dietitian, a food scientist). There is no scientific evidence to support the

Table 4. Summary of the different foodstuffs' misleading opinions compared with EBSF's (self-edited table)

Foodstuff(s), product(s)	Misleading opinions, standpoints (Young and Young, 2006)	Evidence-based scientific facts (EBSF's)
Vegetables	The consumption of a variety of vegetables is recommended (cause: alkaline salts, chlorophyll content)	The consumption of a variety of vegetables is recommended (cause: valuable macronutrient, dietary fibre, vitamins, and macromineral content) (Szűcs, 2016)
	Raw and mild processed vegetables without proper cleaning	Raw and mild processed vegetables (prevention of food-borne diseases recommended with proper cleaning) (CDC, 2022)
	Vegetables with higher carbohydrate content prohibited	A healthy and balanced diet does not avoid any foodstuff without metabolic cause or indication (Szűcs, 2016; Fenton and Fenton, 2016)
Dried legumes	Recommended without prolonged storage or preservation – high protein content, protein source (bloating and/or allergies not taken into account)	Recommended with other vegetables also (except: in different food allergies or uncomfortable gastrointestinal effects) (Messina, 2014; Szűcs, 2016)
Mushrooms	Edible mushrooms are forbidden in the alkaline diet (cause: toxic, poisonous)	No evidence for the edible mushrooms negative effects. recommended in a healthy diet (Szűcs, 2016; Mwangi et al., 2022)
Fruits	High sugar (fructose) content fruits avoided in the alkaline diet („acidifying effect")	No evidence for the high sugar (fructose) content's acidifying effect (Stanhope, 2015)
		This group provides one basis of a balanced and varied diet. Daily consumption is recommended without any restriction (Angelino et al., 2019)
	The consumption of certain citrus fruits (lemon, lime, grapefruit) is highly recommended	No scientific evidence of the special and positive health effects of different citruses compared with the other fruits. In long-term, it can cause a one-sided diet (reduced vitamin and mineral level) and increase the risk of some chronic disease (Zhan et al., 2017; Halvorsen et al., 2021; Hurtado-Barroso et al., 2020).
Milk and dairy products	Milk and dairy products are harmful to the body, according to the principles of the alkaline diet (cause: lactate, hormones, and chemical residues content)	Under strict food product regulation – no evidence for these biological hazard substances in processed milk and dairy products (EFSA, 2022)
		The advantages of consuming fermented or acidified dairy products are obvious. Daily consumption is recommended in a healthy diet (Savaiano and Hutkins, 2020; Barrubés et al., 2019).

(continued)

Table 4. Continued

Foodstuff(s), product(s)	Misleading opinions, standpoints (Young and Young, 2006)	Evidence-based scientific facts (EBSF's)
Meat, meat products, harslet, eggs	Strongly limited amounts of animal proteins (cause: same like milk and dairy products)	Whole proteins, amino acids, valuable minerals and vitamins found in meats truly are important factors of a balanced and varied diet. The restrictions of the alkaline diet can lead to the derivation of states of deficiency and diseases because of the absence of several minerals (e.g. iron) and vitamin B_{12} (Szűcs, 2016; Hovinen et al., 2021)
Pisces	Fish can be consumed occasionally in the alkaline diet.	The allowance of fish consumption is positive from a nutrition point of view because of their eicosapentaenoic acid (EPA), docosahexaenoic acid (DHA), and beneficial fatty acid (Omega-3) content (Djuricic and Calder, 2021; von Shacky, 2021)
Fats of animal origin	The alkaline diet forbids the use of fats of animal origin except fish oil	High saturated fatty acid (SFA) content has a high cardiovascular risk; on the other hand, in an appropriate amount, it can be part of a balanced diet (Szűcs, 2016; Bays et al., 2021)
Oilseeds, vegetable oils	Hydrogenated and refined oils that are susceptible to rancidity and mould growth are completely ignored, while cold-pressed, virgin vegetable oils are recommended.	The opinion is acceptable for the composition of the oils (thus, only an interesting coincidence is the relationship between these two recommendations) and not for other reasons mentioned by Young (e.g. contamination of oils) In a healthy diet, the oilseed and the usage of vegetable oils are recommended in normal amounts. (Szűcs, 2016; Zhao et al., 2021)

efficacy and the prophylactic features of the alkaline diet; thus, it can be stated that an alkaline diet does not support the maintenance of our health, but can rather be harmful due to its rather strict, selective, and restrictive nature. When following this diet, the lack of sufficient calcium and protein intake would increase the risk of several deficiencies.

7. RECOMMENDATIONS

It is crucial to consult a dietitian, a nutrition and food expert, regarding your diet. Do not apply any drastic changes in your diet, as it can endanger your health. Do not believe unconditionally in the advertisements on the internet or in the media, especially, when the advertiser can acquire financial benefits (e.g. selling alkaline products). Do not follow alternative diets that are built on solely one product group, which allow the consumption of only a few foodstuffs or ingredients and exclude many others, and where the access to evidence-based scientific information is limited regarding the effect and consequences of those diets and products promoted.

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