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**DIETETIC TREATMENT OF FUNCTIONAL
CONSTIPATION IN CHILDREN: A SCOPING REVIEW
WITH NARRATIVE SUMMARY**

**Leczenie dietetyczne zaparcí czynnościowych u dzieci: przegląd rekomendacji
i tradycyjnych terapii**

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A - Koncepcja i projekt badania, B - Gromadzenie i/lub zestawianie danych, C - Analiza i interpretacja danych, D - Napisanie artykułu, E - Krytyczne zrecenzowanie artykułu, F - Zatwierdzenie ostatecznej wersji artykułu

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Abstract (in Polish):

Zaparcie czynnościowe jest jedną z najczęstszych diagnoz gastroenterologicznych u chorych w wieku rozwojowym. Charakteryzuje się zmniejszoną częstością, zazwyczaj bolesnego, oddawania stolców, które mogą być twarde. U części chorych występuje popuszczanie stolca i nawracający ból brzucha. Zgodnie z międzynarodowymi rekomendacjami, pierwszym etapem leczenia jest wstępne opróżnienie jelita z zalegających mas kałowych z podtrzymującą terapią glikolem polietylenowym (makrogolem) i ewentualnie innymi lekami przeczyszczającymi, edukacja chorego i jego opiekunów oraz rekomendacja odpowiedniego spożycia błonnika pokarmowego, płynów oraz aktywności ruchowej. Wobec długotrwałej terapii glikolem polietylenowym i innymi środkami przeczyszczającymi u dzieci

z zaparciami nawykowymi, rodzice wyrażają obawy o trwałe uzależnienie od leków i ich działanie uboczne. Pielęgniarki są mniej skłonne od lekarzy korzystać z długotrwałej farmakoterapii zaparcć i preferują modyfikacje diety wraz ze zmianami stylu życia. Jednakże, dostępnych jest niestety niewiele badań naukowych o wysokiej jakości, które poświęcono interwencji dietetycznej u chorych w wieku rozwojowym z zaparciem czynnościowym.

W artykule przedstawiono rolę modyfikacji diety w zapobieganiu i terapii zaparcia nawykowego u dzieci oraz propozycje praktycznych rozwiązań dla profesjonalistów medycznych zajmujących się chorymi z tym problemem zdrowotnym. Za cel przyjęto przekazanie jak największej liczby szczegółowych wskazówek by wyjść poza ogólnikową rekomendację zwiększonego spożycia błonnika pokarmowego. Wykorzystując doświadczenia kulinarne oraz medyczne z wielu kultur zaproponowano krytyczne podejście do wyboru, bądź unikania, niektórych warzyw, owoców, zbóż i technik kulinarnych.

Abstract (in English):

Functional constipation is one of the most common gastroenterological diagnoses in paediatric patients. It is characterized by infrequent, painful, and hard stools and frequently may be accompanied by abdominal pain and faecal incontinence. According to international guidelines, the first steps in the treatment of children with functional constipation include initial disimpaction followed by maintenance treatment with polyethylene glycol and other laxatives, education and recommendations for fibre, fluids and physical activity. Parents of children with functional constipation are hesitant to administer medications for prolonged periods due to a fear of dependence on laxatives and perceived side effects of stool softeners. Nurses are less likely than doctors to use pharmacologic options to treat chronic constipation, preferring diet and lifestyle modifications. However, there is a shortage of high-quality studies on the dietetic treatment of functional constipation in children.

This article outlines the role of diet in preventing and managing functional constipation in children and offers practical advice for medical professionals caring for this group of patients. The aim of the paper is to provide practical and reliable advice on this topic, which is often dismissed with a statement about the need for increased fibre intake. Numerous tips have been compiled on choosing certain vegetables, fruit and grains while avoiding others, culinary techniques and recipes, the use of culinary heritage and traditional medicine insights.

Keywords (in Polish): zaparcia, pasaż okrężnicy, modyfikacje diety, tradycja kulinarna.

Keywords (in English): constipation, colon transit, diet modifications, culinary tradition.

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Dietetic treatment of functional constipation in children

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Introduction

The global prevalence of idiopathic constipation is 14% [1]. Among adults, constipation, which is highly correlated with insufficient food and fluid intake, affects 42.4% of end-stage oncology patients and is one of the most frequent symptoms besides pain and cachexia [2]. Constipation constitutes 10–25% of paediatric gastroenterology referrals. The Rome criteria separate functional constipation (FC) from irritable bowel syndrome with constipation [3,4]. FC, for which there is no organic cause, is the most common type of constipation in children and adolescents. Only approximately 5% of constipation cases in children and adolescents can be attributed to an underlying aetiology, such as anorectal malformations (e.g. anal stenosis), neuromuscular disorders (e.g. Hirschprung disease), Eagle-Barrett syndrome (so-called prune belly syndrome), cystic fibrosis, Down syndrome, coeliac disease, endocrine conditions (e.g. hypothyroidism, vitamin D toxicity) and food allergies [3,4]. Neurodevelopmental disorders and other chronic disorders in children associated with reduced physical activity can be accompanied with FC, as it is difficult for them to sustain the required bowel habits. The initiating event of FC in children, including generally healthy subjects, can be stressful occasions (birth of sibling, parental strife/divorce, sexual abuse), forceful toilet training, illness with dehydration, non-availability of toilets of the standard to which a child is accustomed (toilet phobia), as well as implementation of a strict daily schedule with no slack moments, and is a painful bowel movement which leads to voluntary withholding of stools by the patient who wants to avoid unpleasant and frightening defecation [5]. There is also a group of young patients ignoring the urge to have a bowel movement because their attention is focused on other extremely interesting activities for them [6,7]. With time, stool retentive behaviour with the resultant absorption of fluids and harder stools becomes an automatic reaction. Stool retention can be disguised as a child's urge to defecate and paradoxically liquid stool from the proximal colon may percolate through the hard retained stool plug and pass the rectum involuntarily. Almost every third child with FC develops faecal incontinence. It has been observed that the longer the history of habitual constipation, the more attention and time treatment requires [1,4-6].

Non-pharmacological management is the first step in the treatment of FC, including the promotion of regular bowel habits and the prevention of further stool retention. This is based on dietary modifications, behaviour interventions, caregiver education, disimpaction if needed, and close follow-ups. Disimpaction can be achieved through oral (polyethylene glycol/PEG/macrogol, lactulose and magnesium hydroxide, so called milk of magnesia) or rectal medications (enemas, glycerine suppositories, suppositories with bisacodyl) [4]. In those cases where diet modification and adequate fluid supply do not help, pharmacological maintenance therapy is performed. PEG is a first-line maintenance treatment, while pharmacologic osmotics such as lactulose, especially for

those not tolerating macrogols, and milk of magnesia are considered second-line [4]. Stimulants like bisacodyl or senna, and lubricants (mineral oil) are also used. It is important to establish a diet that reduces the need for drugs. The anti-constipation properties of a meal can be classified based on their most likely mechanism of action, such as bulk forming (e.g. pasta dishes based on konjac), stool softener (e.g. salad with ground flax seeds), osmotic (e.g. plum soup) and stimulant agents (e.g. goulash with figs).

The diet model must be adapted to the cultural patterns and openness of parents to new nutritional ideas, the individual food preferences of a child, the amount of time required to prepare meals, and family income. Any recommendations must be manageable and acceptable to the family. A recovery rate of 50% to 60% is reported after one year of intensive treatment [3]. Once the child is passing regular soft stools without difficulty or soiling, the maintenance medication may be weaned, but never stopped abruptly as this can cause relapse. In every fourth child with FC, symptoms persist into adulthood. The very recent systematic review and meta-analysis of dietetic treatment for children with FC by Wegh et al. [8] revealed only six studies, five of which had high risk of bias, and minimal evidence that supplements like *Cassia fistula* (Indian laburnum), flaxseed seeds (tansymustard), green banana biomass, black strap molasses and Xiao'er Biantong granules, composed of seven herbs, may be effective. Some prebiotics and fibre mixtures are effective treatments, whereas no evidence was found for the use of probiotics or synbiotics [8,9]. Of course, there is theoretical merit to looking for new bacterial strains with anti-constipation effects [12]. Over a third of parents of children with FC seek help in the form of complementary or alternative medicine [10]. They often search for miracle foods and diets [9]. Nurses are less likely than doctors to use pharmacologic options to treat chronic constipation, preferring diet and lifestyle modifications [11].

The aim of this work is to indicate directions for modifying the diet of a child with FC, which although lacking in hard scientific confirmation, at the same time deserve attention because they result from centuries-old traditions, observations of folk medicine, as well as benefiting from fragmentary experimental and clinical observations, most often concerning adult patients.

DIET MODIFICATIONS

Fibre

Various high-fibre foods lead to reductions in whole gut transit time. Fibre is defined as the sum of non-digested and non-absorbed carbohydrates in the small intestine that are polymers of three or more monomeric units, and insoluble and unfermentable lignins. The forms of fibre differ in solubility, viscosity (degree of resistance to flow) and fermentability, which affects water-binding and the ability to increase the volume and reduce the hardness of stool. Water-soluble fibres include gums (tara gum, guar gum, locust bean gum or carob gum), pectin (apples, quinces, pears, guavas, gooseberries, citrus fruit), mucilage (flax seeds, root of marshmallow plant), psyllium (ispaghula) and glucomannan, which is part of konjac, salep and fenugreek. Interestingly, in paediatric gastroenterology, dietary supplementation with isolated fractions of soluble fibre (e.g. glucomannan, psyllium) is not promoted [12]. Fermentable fibre has a special effect on the microbiota and production of short-chain fatty acids (butyrate, propionate, acetate etc.), which increase osmotic load and accelerate colon transit. Wheat bran is insoluble and slowly fermentable. Sorbitol is a sugar alcohol with a sweet taste, which is slowly metabolised in humans. Having the ability to withhold

water, sorbitol is not digested or absorbed in the small intestine but is fermented in the colon, which increases the pool of short-chain fatty acids.

The recommended daily fibre intake is based on age (in years) + 5(-10) g/day [12]. There is 2.5g of fibre in one apple with skin. Citrus peels contain approximately 30% of pectin and are globally an important raw material for the production of pectin [13]. In Asian medicine, dried trifoliolate orange (Chinese bitter orange, *Citrus trifoliolate*, *Poncirus trifoliolate*) has numerous uses, including the reduction of intestinal transit time [14]. The plant is a fairly cold-hardy citrus and will tolerate moderate frost and snow. Therefore, it is increasingly more often cultivated by amateurs in the colder parts of Europe. Citrus peels provide many different health-promoting chemical compounds [15]. This may lead to an attempt to use citrus fruit peel in one's diet in accordance with already existing culinary traditions (**Table 1**). It is worth highlighting that a very high fibre intake (for adults >50g/day) is not necessary and may even be problematic, causing abdominal distension and flatulence [7]. In a patient with adequate supply of fibre and lack of normal bowel movements, attempts can be made to change the proportions of fibre fractions. For example, a child selectively eating potatoes and/or sweet potatoes, rich in soluble fibre, may benefit from the supply of mucus and insoluble fibre. Large seeds are known to expand the interior walls of the colon and ease the passage of waste [17]. **Table 2** lists fruit containing seeds, which can stimulate peristalsis by mechanical action. Insoluble types of fibre act on intestinal transit by means of an irritative on the mucosa, which, in turn, induces the secretion of water and mucus [7]. The amount of consumed high-fibre peel of vegetables and fruit can be increased by the conscious choice of individual fruit and vegetables. It is better to crush a tomato or cut it into thin half slices than to blanch it and remove the skin. Fruit and vegetables with a smaller diameter will provide more peel per product weight, such as thin pods of green bean or cowpea pods, Daikon turnip with a long and thin root, small radish, long and thin cucumbers, small tender zucchini and aubergines, and cherry tomatoes. A spherical tomato with a diameter of 6cm has almost half as much skin as six small tomatoes of the same combined weight. In South Korea, a higher incidence of constipation has been observed in young children with a low number ($3 \leq$) of servings of fruit and vegetables per day [5]. Cherry tomatoes, kiwi berries and radish halves are examples of easy snacks. In the search for foods that facilitate defecation in a child with FC, the focus should not only be on fibre but also on the little-known synergy of various dietary components [7]. Flavonoids and polyphenols concentrated in the peel of fruit and vegetables can beneficially regulate mast cell homeostasis in the intestine, which has a significant impact on the motility and secretions of the digestive tract [19,20]. It is worth remembering that a side effect of antihistamines, especially the first generation, is constipation [21]. Quercetin is a major flavonoid, ubiquitously distributed in edible plants. Its best bioavailability is from onions, apples and dates [20]. Quercetin influences the levels of motilin (\uparrow), gastrin (\uparrow), somatostatin (\downarrow), acetylcholine esterase (\uparrow), as well as intestinal mucosa repair [22].

It is better to eat raw or steamed vegetables than cooked ones, because very high temperatures may destroy some of their beneficial substances.

Table 1. Citrus peel in culinary tradition

Tabela 1. Skórka owoców cytrusowych w kulinarnej tradycji

Lemon
- fresh peel as an addition to various foods and drinks ¹
- dried whole lemons
- whole "Moroccan style" pickled lemons ²
- Egyptian and Libyan thinly sliced and salted unpeeled lemons (<i>lamoun makbouss</i>)
- unpeeled lemon jelly
Lime
- fresh peel as an addition to various foods and drinks
- dried Persian whole lime powder (<i>limu omani</i>)
- dried whole limes
- unpeeled lime jelly
Bitter orange (Seville orange)
- fresh/dried peel as an addition to various foods and drinks
- unpeeled orange jelly (British orange marmalade)
- pickled unpeeled bitter orange (Indian cuisine)
Orange
- fresh/dried peel as an addition to various foods and drinks ¹
- candied peel
Citron
- pickled unpeeled citron
Desert lime (<i>Citrus glauca</i>)
- candied peel
Kumquat
- eaten unpeeled fresh
- marmalade

Table 2. Fruit containing relatively large pips on the flesh, which can be easily eaten fresh

Tabela 2. Wygodne do jedzenia na surowo owoce z pestkami w miąższu

Grapes
Pear
Currants (black, red, white)
Gooseberry
Jostaberry ³
Chokeberry
Pomegranate ⁴
Passion fruit (maracuja)
Kiwano (horned melon, jelly melon)

1 In Polish cuisine, the so-called dietary sauce (*sos dietetyczny*) for cooked meat was used frequently, which consisted of broth, butter, lemon or orange juice and overcooked lemon or orange peel [16]. The delicacy was veal tripe with lemon zest.

2 Ripe fruit are soaked in fresh water for three days while changing the water to reduce bitterness, and then salted and preserved in containers.

3 Hybrid involving three original fruit species: the North American coastal black gooseberry (*Ribes divaricatum*), the European gooseberry (*Ribes uva-crispa*), and the blackcurrant (*Ribes nigra*).

4 There are also commercially available dried pomegranate arils.

Dragon fruit (pitaya)
Japanese silverberry ⁵
Rowanberry ⁶
Watermelon ⁷

Fluids

It is generally believed that it is best for a child with FC to drink water and not fruit or vegetable juice, which contains little fibre and can be high in calories, therefore possibly displacing other desirable foods from the diet [6]. Apple, pear and plum/prune juice, however, contain sorbitol that stimulates intestinal peristalsis, which in paediatrics is known from the toddler diarrhoea phenomenon. The recommended dose of prune juice for an infant of less than one year of age, is 1 to 3 mL per kg, once or twice per day. The degree of ripeness of the fruit can have a significant impact on the effect of the juice on the digestive tract. In adults, immature prickly pear (*Opuntia ficus-indica*) juice lowers gastrointestinal transit time. The same doses of mature juice resulted in significantly higher gastrointestinal transit time and lower faecal water levels. From a medical professional point of view, the acceptability of the presence of juices in the diet of a child with constipation decreases with its age [12]. For the youngest children who refuse to drink water, an alternative may be an unsweetened compote of dried figs, apricots and plums [6]. Berries and their juice are a source of xylitol with a sorbitol-like effect [23–25]. For a child who cannot chew fruit or is reluctant to do so, a practical solution may be the preparation of whole-fruit smoothies (drinks made with fresh, puréed fruit). It is also worth considering water rich in magnesium [7,9,26]. The main advantage of magnesium is its osmotic effect due to its incomplete absorption [7]. The recommended fluid intake is approximately four cups per day for children one to three years of age, five cups for children four to eight years of age, and seven to eight cups for older children [27]. Milky or carbonated drinks/sodas should not be counted in the daily total, and neither should the fluid used to reconstitute PEG laxatives. Forcing a large over-normative supply of fluids is not justified because, while low fluid intake as a whole has been associated with constipation, increasing fluid intake alone has not been shown to have a beneficial role in treating FC in children [5,8,9].

Fruit

Fruit thought to be most useful for treating constipation includes apples, pears, plums, apricots, gooseberries, figs, dates, grapes with seeds, kiwis, guavas, pineapples, cherries, loquats (Chinese plums) and mangoes [6,12,14,28–30]. It is important not to offer seedless varieties of grapes (**Table 2**) and become accustomed to eating whole or grapes halved with a knife. Numerous bioactive chemical compounds with anti-constipation properties, e.g. actinidin and kissper, have been identified in green kiwifruit (*Actinidia deliciosa*) [31]. The proteolytic activity of the enzyme actinidin (cysteine protease) is eight times higher in green kiwifruit than in gold kiwifruit (*Actinidia chinensis*). The kiwi berry (*Actinidia argute*), also called mini kiwi and soft kiwi, has smooth and hairless skin, which does not require peeling and can be eaten whole. Kiwi consumption has been associated with a significant increase in defecation, stool softness and volume, and ease of defecation. Fruit containing proteases similar to actinidin include figs (ficin), papaya (papain), pineapple

5 Yellow-fruit varieties of *Elaeagnus umbellata* are tastier than red-fruit ones.

6 After freezing from special improved varieties of *Sorbus aucuparia*. Rowanberries are rich in sorbitol.

7 In South Africa, traditional healers use roasted watermelon seeds to improve appetite and relieve constipation [18].

(bromelain), noni (Indian mulberry, *Morinda citrifolia*) and probably Asian pears. Noni fruit are readily available in dried form; however, the safety of their consumption by children has not been studied [32]. Overall, prunes, cherries and apricots, which are rich in fibre and sorbitol, increase faecal output in both animals and humans [14]. Folklore from countries around the world highlights dates as a potent remedy for constipation [30]. The beneficial effect of apples in the treatment of constipation is reduced by thermal processing [6,33]. It is also risky to base the supply of vegetables and fruit on jars for the first months of life [6]. For young children a practical choice is apples with the skin grated on a glass grater, and not baked or cooked. Apple varieties differ, among others, in the content of polyphenols and their effect on intestinal flora [14]. Unfortunately, there is no detailed analysis of their impact on the digestive tract apart from three varieties: Pink Lady, Golden Delicious and Renetta Canada [14]. It is worth encouraging caregivers to observe carefully the expected differences in the effects of eating different varieties of apples.

There is consensus on the need to exclude bananas (globally traded varieties) and persimmons (kaki fruit) from one's diet [6,12]. The tannins from bananas and persimmons can cause or aggravate pre-existing constipation [34]. The total quantity of tannins decreases as persimmons increase in size. Healthy individuals, however, may experience painful defecation when ripe and less bitter big persimmons are eaten [12].

Vegetables

Red beets have been used in traditional medicine for hundreds of years to treat constipation [35]. The Romans appreciated the benefits of figs and red beets in this respect [36]. Cooked red beets can be used in warm and cold salads and as an addition to cookies, bread, ice cream, lassi and probiotic drinks [37]. In Persia, beetroot enemas were used, as well as suppositories formulated from bitter cucumber and *Astragalus fasciculifolius* [38,39]. The flesh of Chioggia beets has visually interesting concentric red-white rings and this old variety is suited for raw consumption. The use of broccoli [6], zucchini [40], cucumbers [41] and legumes [6,28,41] is recommended in the diet of children with FC. Unfortunately, there are no detailed studies on what criteria to use when choosing cruciferous vegetables for patients with constipation, as they undoubtedly differ in the content of chemical compounds with regulatory potential and prebiotic properties, and might even hinder the functioning of patients by causing bloating through increased consumption [20,42,43]. It is not recommended to eat cabbage during lactulose therapy. A similar problem concerns the selection of legume seeds, which are a source of large amounts of lectins [20,44,45]. Raw and cooked *al dente* parsnip roots can probably form a beneficial part of the diet of a child with constipation [46]. The roots of rhubarb (*Rheum officinale*) with anthraquinone derivatives, and other botanical medicines for constipation, such as slippery elm, cascara and senna, were recently reviewed by Santucci et al. [9]. The aboveground parts of culinary rhubarb (*Rheum x hybridum*) are used not only to prepare compotes, but also dishes à la spinach made of leaves and leaf stalks, and marmalades. The addition of rhubarb marmalade improves the taste of spinach dishes and has been recommended to stimulate intestinal peristalsis [16]. Cut rhubarb stalks can be added to stewed meat.

Carrots, especially when cooked [41], have been traditionally used to treat infectious diarrhoea. Served as the first solid food to young infants, they are often constipating. It is recommended to consider excluding carrots from the diet of children with FC. An exception may be to serve occasionally and in small amounts unscrapped raw Paris market (Marché de Paris) and *manpukuji* carrots. Pumpkin may have a similar constipating effect to carrot. There is no evidence to recommend

a low-FODMAP diet in children with FC [47]. Vegetable soups are an alternative way to consume the recommended vegetable portions [7]. Fennel and beetroot, as they are normally not liked, can be disguised in a soup. Fresh or frozen herbaceous plants, whose stems are traditionally pickled, can be low-caloric ingredients in soups after grinding (**Table 3**). Iranian cuisine can offer special inspiration for composing soups for a child with constipation with dishes such as barley soup (*ash-e jow*), oat soup with turnip, zucchini, white cabbage and dill (*sup-e jow-e do sar*), and pomegranate soup with, among others, ingredients such as beets, fresh beet leaves and barley (*ash-e anar*). The laxative properties of selected dishes are probably not the result of one particular phytochemical but rather the accumulative effect of various phyto-constituents ranging from fibres, phenols and flavonoids to minerals.

Table 3. Herbaceous plants whose stems are pickled
Tabela 3. Rośliny zielne, których pędy są marynowane

family <i>Apiaceae</i> :
– Chervil (French parsley, <i>Anthriscus cerefolium</i>) ⁸
– Horse fennel (<i>Hippomarathrum siculum</i> / <i>Cachrys sicula</i>) ⁹
– Giant fennel (<i>Ferula communis</i>) ¹⁰
– Persian hogweed (<i>Heracleum persicum</i>) ¹¹
– Wild celery (garden angelica, <i>Angelica archangelica</i> / <i>Archangelica officinalis</i>) ¹²
– Ashitaba (<i>Angelica keiskei</i>) ¹³
family <i>Fabaceae</i> :
– Fenugreek (<i>T. foenum graecum</i>) ¹⁴
family <i>Asparagaceae</i> :
– Asparagus (<i>Asparagus officinalis</i>) ¹⁵
– Solomon's seal (many species from the <i>Polygonatum</i> genus) ¹⁶
– Hosta (funkia, <i>Hosta montana</i>) ¹⁷

Bakery products

Bread made of purified wheat flour is most often excluded from a patient's diet [6,41]. More fibre is contained in Graham bread, which unfortunately is often avoided by young children. Bread made from rye, depending on taste acceptance, with the highest possible proportion of wholemeal flour, and teff injera made from sourdough have an established position in the treatment of FC

8 Popular in Armenian, Kurdish and Yazidi cuisine.

9 Popular in Armenian cuisine.

10 Belongs to the Moroccan culinary tradition. It is presumably only safe to eat young shoots in small quantities.

11 Young leaf stalks (pickles are called *golpar torshi* in Persian). Interestingly, in Iran, dried seeds of Persian hogweed are sold in powdered form (*golpar*), while in other countries they are often erroneously sold as "angelica seeds".

12 The stems are also crystalised in sugar syrup and coloured green as cake decoration or candy. In irritable bowel syndrome of the constipation predominant type, the root of *Archangelica officinalis* is regarded as helpful [48–50].

13 Recently, the plant has been gaining increasingly more interest in horticulture. All above-ground parts and the root are eaten.

14 The cooked stems and leaves of fenugreek (called *methi saag*) are very popular in Northern India and Nepal as a winter vegetable.

15 Traditional Persian medicine valued the anti-constipation properties of the asparagus root up to 8 grams per day [38,39]. In Poland, decoctions of asparagus roots, senna leaves and prunes were used [16].

16 Many species of *Polygonatum* are eaten in Asia, Europe and North America.

17 Very popular in Japan and Korea.

[11,12,51]. Sourdough bread retains its taste and freshness longer. Self-baking bread at home opens the possibility of making interventions regarding its composition and allows for creative exploration. It is possible to bake bread with admixtures of wholegrain flour from oats, buckwheat, barley, teff, cereal flakes (e.g. oats flakes) and bran, as well as flour obtained from the residues of fruit and vegetables [52,53]. Bran and powdered fibre supplements may be helpful when a sufficient amount of fibre is not taken through food [7]. Nuts, such as crushed or ground walnuts, sweet almonds and seeds (e.g. pumpkin, linseed, nigella, nigella cumin, cumin, coriander, fenugreek and hemp) are easily added to bread. The literature provides observations showing the desirability of such supplementation [54–58]. In Poland, flaxseed is very often used in self-treatment and in the prescribed treatment of FC; however, despite positive observations of effectiveness in adults, there are no scientific studies in children [9,59]. In nineteenth-century Poland, fruit bread with the addition of dried figs, raisins, plums, pears, walnuts and sweet almonds was used in the treatment of FC [16]. Bread dough was made from wheat flour, yeast, plum brandy (slivovitz) or kirsch. The finely chopped fresh stems and leaves (also dried after soaking) of herbs, e.g. fenugreek, coriander, hyssop, Afghan leek (*gandana*) and culantro (spiny coriander, recaon, *Eryngium foetidum*) can be added to the bread dough.

Fenugreek (*Trigonella foenum-graecum*) holds a special place in bakery and FC treatment [39,60]. Flour fortified with 8–10% fenugreek flour has been used to prepare bakery foodstuffs, such as bread, cakes and pizza, with acceptable sensory properties. In wheat biscuits, wheat flour can be replaced by 10% soaked fenugreek or 20% germinated fenugreek flours to produce acceptable and highly nutritional biscuits [60]. Both the seeds and leaves of fenugreek are used in the baking of barley biscuits. The anti-constipation effect of barley is particularly emphasised by traditional Persian medicine [38,39]. Considered as the national Georgian spice, blue fenugreek (*Trigonella caerulea*), with a milder taste than fenugreek, has interesting uses in Swiss and Northern Italian cuisine, where it is locally called *Blauklee*, *Schabzigerklee* or *Brotklee*. Swiss green cheese (in German *Schabziger*) with ground leaves of blue fenugreek is known as Switzerland's oldest protected brand. *T. caerulea* is an addition to the traditional rye sourdough bread baked in the South Tyrol.

Pasta, pizza, pancakes and cornflakes

Globalisation, the adoption of American cultural patterns and the undoubted advantages of the Italian cuisine have contributed to the consolidation of the high standing of cornflakes and spaghetti in a Westernised diet. Expanding the diet of infants with rice cereals is sometimes associated with the risk of FC [27]. Unfortunately, standard breakfast cereals, spaghetti and noodles are low in fibre and can promote FC. Standard wheat spaghetti can be replaced with products containing buckwheat, and noodles made from soybean and other legumes, such as green peas and lentils, as well as konjac. Cornflakes, rice flakes, sweetened muesli and cuscus are replaced by various combinations of extruded buckwheat, amaranthus, quinoa, millet, cocoa husk, oat and barley flakes, and bran [6,28]. An alternative to classic pancakes are buckwheat, oat and teff pancakes or pie from fermented black glutinous rice [61]. Changing the taste of porridges and pearl barley risottos by adding pure salep (sahlab, powdered dried orchid root of *Orchis mascula*) was a recommended trick used to encourage children to eat and to stimulate intestinal peristalsis in Polish dietetics textbooks of the nineteenth century [16]. Nowadays, salep is used in Arabian, Turkish, Persian, as well as in Mizrahi Jewish cuisine, which makes it possible to buy this product in ethnic stores.

Potatoes and French fries

Among patients with FC there are children selectively fond of potatoes. Instead of boiled or baked potatoes and sweet potatoes, the lunch dish may include oat groats, buckwheat, millet, pearl barley and adlay [6]. A substitute for French fries can be prepared from celeriac and yacón [62]. In semantic terms, for example, in Poland we find a sort of preference for unpeeled potatoes, which are affectionately called *ziemniaki w mundurkach* (potatoes in uniforms). In potatoes, the skin does contain approximately half of the total dietary fibre [63].

Additives to meat and egg dishes

In contemporary literature, there are no recommendations regarding the choice of the type of meat, or adjustments to the amount of meat, fish and eggs consumed by children with FC. In South Korea, a link between the lack of meat consumption and the risk of constipation in young children attending day care centres has been documented [5]. In ancient Persia, the beneficial properties of rooster meals with the use of tamarind were pointed out [38,39]. Meatballs and minced meat cutlets are an easy acceptable carrier of beetroot shavings, parsley and artichoke leaves for children who avoid these vegetables [64]. Flax flour may even be added to meatballs [65]. Goulash-type dishes can be easily enriched with fibre by adding fresh or dried figs, jujube (due to flatulence, after consumption, traditional Persian medicine limits daily consumption to 5–10 fruits [38,39,66]), quinces, large-fruited hawthorn (e.g. tejocote/manzanita, fruits of *Crataegus mexicana*), medlars and mushrooms. From the Persian and Ottoman cuisine, a dish worth popularising is quince stuffed with lamb, which is a useful example of using a savoury version of this pectin-rich fruit. For a small child who likes eggs, instead of boiled eggs or scrambled eggs, it makes more sense to serve meals that modify rich vegetable dishes, such as an Italian *frittata*, Arab *eggah*, Turkish *menemen*, Maghrebi *shakshuka* or the Persian *kuku*.

Honey

Honey is used in the treatment of FC in various forms, from oral administration to suppositories and rectal enemas. It is popular to give water or weak tea with honey in the morning for children over one year old [6]. In Poland, honeydew honey was used for this purpose, and although this knowledge has been forgotten in recent decades it could significantly enhance the effectiveness of intervention. Honeydew honey is made by honeybees from the excretions of plant-sucking insects (*Hemiptera*). Trisaccharide melezitose, as well as an increased level of trehalose and a decreased level of phenylalanine are regarded as characteristic features of honeydew honey. The amount of amino acids in honey is about 1% (w/w) and honey is not usually excluded from the diet of patients with phenylketonuria; nevertheless, with a larger supply of honey in PKU patients with FC the optimal choice is fir honeydew honey, which contains the lowest amount of phenylalanine. Interestingly, Caspian manna (in French, *manne de perse*, a tear-like shaped yellow-brown substance of 1–3mm in diameter), which consists mostly of melezitose, saccharose and invert sugar, is produced by larvae of *Poophilus nebulosus* feeding on host plant *Alhagi maurorum* (so-called camelthorn bush). In traditional Islamic medicine, manna is claimed to be useful in the treatment of constipation, anorexia and obesity [67]. The prebiotic-like influence of melezitose on intestinal microbiota has not been researched. In historical records, honey was also served with various herbs, including *Mentha* [68]. In South Asia, the flesh or fresh juice of Indian gooseberry (amla, *Emblica officinalis*) mixed with honey is a remedy for constipation [69]. Dried fruit of amla, *Terminalia chebula* and

Terminalia belerica, are equally parts of the Ayurvedic medicine for constipation (*triphala*, three fruit in Sanskrit) [9]. In the nineteenth century, special fig slices (*krajanka figowa*) were recommended in Poland. These consisted of very finely cut juicy figs, plum butter and honey ('in sufficient quantity in the morning and evening, it stimulates the intestines' [16]). In Iran, the unwavering interest in ready-made mixtures of fresh rose petals (*golghand*, from *Rosa damascene*) and honey may indirectly prove their usefulness in the treatment of constipation. Various flowers can be used in cooking, and this is not only due to the current fashion of using the flowers of wild plants [70] (Table 4). In Iran, traditionally in the event of side effects during anti-constipation treatment based on the seeds of fenugreek (headache, nausea), apricots (flatulence) and garlic (headache), oxymel (from the Latin "acid and honey", a mixture of honey and vinegar) is used [38,39]. Both honey and oxymel are recommended for CNS side effects during treatment with seeds of *Plantago ovata* and nausea after dill treatment. Discomfort after eating turnips was supposedly eliminated by salted honey. For children who do not like drinks with honey, selected cakes with a high amount of honey can be prepared, including *chonek tejkech*, the recipe of which comes from the East European Ashkenazi Jew cuisine, where it is a popular wedding cake.

Table 4. Edible flowers and flower buds often used in food preparation and readily available in stores

Tabela 4. Dostępne w sprzedaży kwiaty i pąki kwiatowe często wykorzystywane do przyrządzania posiłków

CLASSIC INGREDIENTS OF A WESTERNISED DIET
Cruciferous vegetables – cauliflower, broccoli, Romanesco broccoli
– fresh
– frozen
– pickled
Artichoke ¹⁸
– fresh
– pickled/salted
Caper buds
– pickled/salted ¹⁹
LESS FREQUENTLY AND LOCALLY CONSUMED INGREDIENTS
Zucchini flowers
– fresh
Caucasian bladdernut (<i>Staphylea colchica</i>) buds and flowers
– pickled ²⁰
Dragon fruit flowers (pitaya; family: <i>Cactaceae</i>)
– fresh
Quince blossom
– fresh
Orange blossom
– fresh

18 For the preparation of foods enriched in probiotics for patients with functional constipation, artichokes rich in prebiotics are used [71]. Cooked artichokes rubbed through a coarse sieve can be added to various meals. Artichoke leaf extracts have a positive effect on constipation [72].

19 In addition to the buds and berries, the leaves are also soaked in brine.

20 *Jonjoli* – Georgian appetiser for lunch dishes.

- dried
Linden blossom
- dried
Rose petals
- fresh
- dried ²¹

Milk products and a milk-free diet

The lack of effects of increasing fibre intake and trying different combinations of foods is a premise for the trial introduction of a diet with a reduced amount of milk and milk-based products or a milk-free diet. Restrictions should not be delayed in patients with overconsumption of dairy products [28]. At the beginning, ultra-processed dairy products are excluded from the diet and the supply of milk is reduced and may be served with the addition of cinnamon or saleg. ‘The addition of saleg causes that some people who have intestinal diseases that do not allow the use of milk tolerate it’ [16]. The next step may be to allow only curdled cow’s milk and kefir in the diet; however, original Bulgarian yoghurts made of sheep (*овче кисело мляко*) and buffalo milk (*биволско кисело мляко*) without the addition of powdered milk are the best choice. Continued lack of improvement is an argument for implementing a strict milk-free diet. Colonic stenosis due to a cow milk protein allergy mimicking Hirschsprung’s disease is well known [76]. The issue of using a milk-free diet to fight habitual constipation has been extensively discussed in numerous reviews [8,12,77]. Regularly eating chocolate and the consumption of “instant” chocolate-milk drinks can be linked to FC [41,78].

Low-calorie vegetables and fruit and searching for helpful culinary compositions

It is worth focusing on the many low-calorie vegetables and fruit in the kitchen and expanding the armamentarium of culinary ingredients for preparing meals. For example, chayote (*mirliton*, *Sechium edule*) can be a valuable alternative to cucumber. We can reduce the calorie content of sweet fruit salads by using yacón, which is rich in prebiotics but not simple sugars [62]. Aside from the common flavour enhancers in vegetable salads, such as vinegar, olive oil and lemon juice [7], verjuice made by pressing unripe grapes may also be used, which is popular in Middle Eastern countries (*hurom* in Arabic, *ab-ghureh* in Persian). A typical Iranian cucumber and pomegranate salad (*salad-e khiar-o anar*), which contains sliced fresh cucumbers, seeds of pomegranate, chopped onions, slivered pistachios, fresh mint, olives, lime juice or verjuice, and the typical Iranian ground spice *golpar* (Persian hogweed seeds) is worth noting. In stuffed vine or cabbage leaves, it is advisable to replace rice with pearl barley, wild rice or buckwheat groats [41]. In recent years, in Poland, a vegan dish consisting of stuffed cabbage with buckwheat and mushrooms, formerly eaten on Christmas Eve, has become increasingly more popular. Both mushrooms and buckwheat may have useful properties in the dietetic treatment of FC [79–81]. The gastro-colic reflex, which goes into effect shortly after a meal, should be used to one’s advantage. The optimal time to pass stool is 10–15 minutes after a meal. Upon waking up in the morning, the ortho-colic reflex, which takes place at the transition from a supine to an upright position, may have a positive effect on defecation. Many older children skip breakfast but this should be discouraged, as breakfast stimulates intestinal motility

²¹ The effectiveness of powdered petals of *Rosa damascena* in the treatment of constipation has been documented in pregnancy [73] and in the elderly [74]. In children, the effectiveness of the mixture of brown cane sugar and Damask rose petals was observed [75].

at the beginning of each day. In the nineteenth century, Polish dietetics textbooks recommended the so-called spicy meatball (*klops korzenny*) to stimulate the digestive tract [16]. Such meatballs were prepared with various types of lean red meat, anchovies, capers, peppers, parsley, onions, rolls and eggs [16]. A small sandwich can be stimulatively enhanced with a vegetable pickle, although traditional Persian medicine advises the exclusion of pickles from the diet of a child with constipation [38,39]. A useful additive stimulating peristalsis in the morning may be a fenugreek paste like Yemenite *hilbe*, made of soaked, powdered *T. foenum graecum* seeds, spiced with a kick of schug and *çemen*, which is a Turkish fenugreek breakfast paste. Irregularity in eating meals makes it difficult to fight constipation [7,27]. Education on normal bowel health and its interaction with food choices aimed at the general public would help to break the taboo of discussing bowel issues.

Culinary seasonality, traditional food products and meals that require attention and dexterity

For patients with FC, culinary seasonality should be a goal to aspire to, because it can provide benefits in the domains of health, well-being and sustainability [70]. Seasonal changes in dietary ingredients create the opportunity to modify the intestinal microbiome to meet the needs of the patient [82,83]. The search for dietary ingredients and openness to new culinary solutions should be presented to caregivers as an enhancing and not an excluding practice. It is important that this advice is given in a clear and comprehensive way to both the patient and caregivers, in the spirit of disseminating appropriate food education. All interviewed Michelin star chefs have indicated that they first ask themselves which products are in season when creating their menu [70]. Traditional food produced on the basis of old technologies also has the potential to influence the intestinal microbiome positively [84]. It is worth testing the effect of naturally fermented plant foods often presented as anti-constipation [85,86] (**Table 5**). Maintaining children's tolerance to adverse dietary experiences, such as eating around bones, consuming sour fermented foods or bitter vegetables, is an important contributor to nutritional balance [87]. Re-framing the capability to eat "difficult" foods as an admirable, broadly useful, life skill would go a long way towards fighting against the predilection for ultra-processed foods, usually with a small amount of fibre, or food neophobia. Not avoiding food that requires chewing is also valuable. A child can be taught to enjoy eating a whole pear with a relatively soft core, not spitting pomegranate seeds, chewing the skin of a loquat, which will not be much after removing stones, or to accept a slightly fibrous bean pod (**Table 6**). On the one hand, many parents of young children are aware of the benefits of choosing wholemeal bread, but on the other hand, they choose baby jars made of peeled apples and pears with modified starch, and fruit pouches for toddlers [88].

Table 5. Popular naturally lacto-fermented vegetables and fruit with the addition of (usually) a small amount of salt and spices (without using vinegar – just “salt and time”)

Tabela 5. Przegląd kiszonych warzyw i owoców

<u>Cucumbers</u> . Traditionally produced in Poland (under the name <i>kiszzone ogórki</i> , which literally translates to lacto-fermented cucumbers), Eastern European countries (in Russian <i>солёный огурец</i> or salted cucumber) and Israel
<u>Head green cabbage</u> . It is known in English-speaking countries under its German name <i>Sauerkraut</i> (which means sour cabbage). Commonly eaten in Eastern European Slavic countries and in European German-speaking countries, as well as in Namibia
<u>Head red cabbage</u> . Product similar to sauerkraut
<u>Napa cabbage (Chinese cabbage)</u> . Kimchi is a traditional Korean side dish, which has become popular in many countries
<u>Tomatoes</u> . Product typical of Ukrainian cuisine
<u>Turnips and radishes</u> . Popular in the Far East and locally in Eastern Europe
<u>Beetroot</u> . Fermented to obtain the juice used in food preparation in Poland and Eastern European countries
<u>Watermelon</u> . Product typical of Ukrainian, Russian and Caucasian cuisine. Whole small watermelons, as well as pieces of skin with a small amount of adherent flesh, are lacto-fermented

Table 6. Often consumed unripe pods

Tabela 6. Często spożywane niedojrzałe strączki

- French bean (green bean) ²²
- Runner bean ²²
- Snow pea
- Sugar snap pea (mangetout)
- Yardlong bean (cowpea) ²³
- Hyacinth bean (lablab) ²⁴

Conclusions

Any deviation from the so-called “normal” toilet patterns can have a significant and distressing effect on people’s physical, psychological and social well-being [11]. Vriesman et al. [4] in their comprehensive review devoted to the management of FC in children and adults pointed out four new directions of pharmacological interventions: pro-secretory agents, serotonergic agents, cholinesterase inhibitors and increased bile acids. It is noteworthy that some foods considered to be especially helpful in the dietary management of constipation have been documented as pro-secretory agents, e.g. peppermint leaves and angelica roots [89], serotonergic agents, e.g. figs [90–92] and Indian gooseberries [93], as well as cholinesterase inhibitors, e.g. honey [94], fenugreek [95] and cumin [96]. Artichoke and black radish (Erfurter radish, *Raphanus sativus* var. *niger*) have been used as cholagogic foods for hundreds of years [21,97,98]. Unfortunately, we do not know the answers to many questions about the dietary treatment of constipation, including how to enhance individual pharmacologic actions through the selection and proportions of raw materials in foods. High-fibre therapy is contraindicated in slow transit constipation with a history of delayed passage of meconium and the onset of symptoms early in the first year of life and/or failure of toilet training; however the increased consumption of foods with colon-specific prokinetic potential, like fig paste,

²² Pods are available in various colours: green, yellow, violet.

²³ In Turkey, pods of *Vigna unguiculata* are the main ingredient of the popular salad *Börülce sallaması*.

²⁴ Pods of *Lablab purpureus* are edible if boiled well with several changes of the water.

and secretagogic herbs (e.g. coriander chutney [28]) may be helpful. Bearing in mind the works on chicory and inulin in the treatment of constipation [99–101], it is practical to search for plant varieties with a particularly changed composition, e.g. prebiotic substances or special food products dedicated to children with constipation. It is warranted to verify for which patients and at what point fibre treatment for constipation should begin [12]. An additional question remains on how to choose the type of fibre and classify constipation for such treatment. Some intrinsic food features, such as particle size and matrix porosity, can modify the fibre availability for the action of fermentation enzymes. The severity of FC may determine the positive effect or its absence after trying certain foods. Kefir helps in mild cases but may intensify very severe constipation [102]. Another important point to note is that the cause for the exacerbation of FC of equal severity is not the same for all patients, and there are as yet unclassified clinical phenotypes. This obviously also affects the response to different dietetic treatments, which encourages creative exploration.

Avicenna and his disciples believed that lack of dietary care leads to children's constipation [38,39]. In most paediatric patients, FC cannot be managed using medication alone [12]. Algorithms for dietary support are needed, which will obviously be preceded by references to culinary traditions and solutions not yet scientifically verified. High-quality studies on children samples are mandatory to provide scientific validity to the role of various foodstuffs in FC treatment and to enable medical professionals to choose the best food combinations.

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