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1 Reply - Letter to the editor "CLNESP-D-23-01405"

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5 In response to "CLNESP-D-23-01405, we wish to thank all authors for their interest in our work. The
6 sole motive behind our narrative review, after learning the lesson from the trans-fat history and its
7 impact on the science and food industry, is to prevent harm before it is too late. We agree with the
8 authors regarding the importance of a worldwide unified definition of dietary fibre, but this should not
9 have potential to worsen symptoms of those with functional bowel disorders nor cause more
10 confusion among the public regarding the health benefits of dietary fibre. Thus, we aim to address the
11 authors' views and concerns, and to provide future recommendations, which will be summarised
12 below. The following abbreviations will be used: FBDs, functional bowel disorders; DF, dietary fibre;
13 LMW DF, low molecular weight dietary fibre; HMW DF, high molecular weight dietary fibre.

14 Key words: Dietary fibre, definition, prebiotics, IBS, functional, flatulence

15 **Addressing Authors' Views and Concerns:**

- 16 1) In their response, the authors defined DF as follows: "Dietary fibre is a group of carbohydrates
17 that are indigestible in the gut, but fermentable by the gut microbiota". This definition is
18 simply incorrect and could not be found anywhere as such in the literature. This erroneous
19 definition places emphasis on the need for DF to be fermented in the gut. Whilst LMW DF is
20 fermentable, HMW DF is either partly fermentable or non-fermentable, depending on its
21 chemical structure. Thus, this definition may have been coined to fit the context of the
22 authors' response, resulting from a professional or financial interest in LMW DF/prebiotics.
23 Alternatively, it may have been due to lack of awareness or misunderstanding surrounding DF
24 definitions.
- 25 2) The authors acknowledge that short-chain carbohydrates are problematic for those with FBDs
26 but argue that gastrointestinal side effects should not be a reason for excluding these
27 carbohydrates from the DF definition. The authors also imply, however, that it is not only
28 those with FBDs who may suffer such effects in response to certain types/quantities of dietary
29 fibre, as they suggest that "personal tolerability and capability" are factors to be considered
30 in all individuals when trying to fulfil daily fibre recommendations. In fact, studies as early as
31 the 1960s have consistently shown that legume consumption produces excessive gases in the
32 vast majority of healthy individuals, not only in those susceptible, such as FBD sufferers[1-5].
33 Legumes have a high oligosaccharide (LMW DF) content, and these oligosaccharides have
34 been reported to be the most deterrent factor for incorporating legume seeds, not only in
35 human diets, but also in monogastric animal diets, due to their flatulence-causing
36 properties[6-9]. The ability of a food to induce the production of excessive gases in any
37 individual is a cause of social distress and embarrassment, but for those with FBDs, it is even
38 more severe as it is associated with abdominal pain, thus having a negative impact on quality
39 of life, posing a health risk, both physically and mentally[10-13]. The role of gas production is
40 so marked in those with irritable bowel syndrome (IBS), that dietary therapies (e.g. low
41 FODMAP and the 5AD diet) and medications (e.g. simethicone, colpermin, and α -
42 Galactosidase) work specifically to reduce this mechanism [14-21]. Taking the above into
43 account, it begs the question as to why oligosaccharides are added to foods, rather than
44 removing them.

45 **Our Recommendations:**

- 46 1) The logic of adding LMW carbohydrates to the DF definition needs to consider a risk-benefit
47 analysis; currently it does not take into consideration the harm caused to those with FBDs, nor
48 the inconvenience caused to the healthy population, as explained above. Therefore, we
49 strongly recommend that gastrointestinal fermentation rate, as assessed by the volume of gas
50 produced per gram of indigestible fermented carbohydrate during a specific timeframe, to be
51 taken as a basis to exclude LMW DF from the DF definition. HMW DF is too complex to be
52 easily fermented by a limited number of micro-organisms and, considering the length of time
53 required, it is likely to occur too slowly, and gradually from the ileum to the rectum, to produce
54 excessive gases and potentially toxic organic acids. These toxic organic acids include short-
55 chain fatty acids, which can form in excess in the ileum or proximal colon.
- 56 2) We also suggest revisiting the concept of prebiotics as it currently relies heavily on LMW DF.
57 Whilst plant oligosaccharides play an important biological role for plants, human milk
58 oligosaccharides have an equally important, but different, biological role for the breastfed
59 infant; thus, human consumption of plant oligosaccharides requires careful thought to avoid
60 any harm. The concept of prebiotics based on plant oligosaccharides needs to be re-
61 considered, due to their well-known flatulence-inducing effect and generation of excess
62 fermentation by-products, as described above and in our narrative review[22]. Also, the
63 bifidogenic/lactogenic effect of prebiotics does not reconcile with the most reported index of
64 a healthy gut microbiome, which is bacterial diversity[23-27]. Bacterial diversity can be
65 promoted by consuming complex carbohydrates, such as arabinoxylan, while the prebiotic
66 effects almost resemble the eutrophication effect of nitrogen in an ecosystem. To put it
67 simply, the complex, long-chained structure of HMW DF limits its accessibility to specific
68 bacterium, as they require diverse microbial enzymes, making it either gradually fermentable
69 or non-fermentable, which is ideal for gastrointestinal health, making the need for prebiotics
70 questionable[14, 15]. Moreover, a *Bifidobacterium adolescentis* strain was reported to alters
71 tight junction integrity and disrupts gut barrier functions and its effect was neutralized in
72 response to the low FODMAP diet[28]. Indeed, if these studies are confirmed, that emphasize
73 the danger of using non-specific bifidogenic agents such as LMW DF prebiotics.
- 74 3) In addition to removing LMW DF from the definition of DF (thus preventing its addition to food
75 products to increase fibre content), we believe that LMW DF should also be removed from
76 natural foods. Although just 15 g/day of galacto-oligosaccharide (LMW DF) from the raffinose
77 family is likely to cause intestinal distress and negative social impact for, not only those living
78 with FBDs, but also any healthy human being, very little attention is paid to oligosaccharide-
79 free products. This is surprising, given that lactose malabsorption (associated with a tolerance
80 of up to 15g/day of lactose), which does not always translate into lactose intolerance
81 (presence of symptoms), for example, features a whole range of highly marketed lactose-free
82 products aimed to help susceptible individuals. Many food processing techniques have been
83 reported which could remove LMW DF from natural foods, such as a simple methods like
84 autoclaving, followed by draining, demonstrating that producing oligosaccharide-free
85 products is a commercially feasible option [3, 9, 29, 30].
- 86 4) The fundamental physiochemical properties of HMW DF, such as its viscosity, bulking and gel
87 forming ability, and its subsequent mopping effect, are completely lacking in LMW DF, which
88 leaves us abashed at the rationale for its inclusion within the DF definition in the first place[14,
89 15]. The mopping effect of HMW DF reduces mucosal exposure to deleterious substances,
90 absorbs gases such as hydrogen sulphide, and limits access to microbial fermentation. These
91 are all valued physiological effects which are beneficial for people with FBDs. On the other

92 hand, unlike HMW DF, LMW DF is associated with properties that are strongly implicated in
93 the aetiology of FBDs, such as flatulence induction, raised osmotic pressure, and increased
94 bacterial biomass[14, 15, 31]. The trend of adding LMW DF to food products is unlikely to
95 attract the consumer in the longer term, especially if it induces gastrointestinal side effects,
96 nor will it help the public appreciate the beneficial effects of HMW DF. We remain of the
97 opinion that higher intakes of HMW DF should, instead, be promoted. This is not a fully new
98 concept, and aligns with the default definition of DF, which was applied in many countries,
99 such as the UK, until recently when the inclusion of LMW DF was adopted.

100

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