

Effects of nutribullet processing on glycemic response



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The major results from the present study show that processing a variety of fruits with the Nutribullet has had beneficial effects on the postprandial glycemic response in healthy subjects. We observed that after the ingestion of the Nutribullet mixed fruit treatment, on average the subject's maximum glycemic increment was only 0.4 mmol/L, in comparison to the maximum increment of 1.3 mmol/L after the ingestion of whole mixed fruit.

In contrast, processing mango with the Nutribullet showed to have no added beneficial effects on postprandial glycemic response in comparison to the ingestion of whole mango. After the ingestion of the Nutribullet processed mango the maximum glycemic increment was 0.9 mmol/L, compared to the maximum increment of 0.8 mmol/L in the whole mango group. Although the processing of mango did not have the same effects seen for the mixed fruit group, these results are still significant because they demonstrate that the domestic processing mango alone and processing a variety of fruits together does not increase their GI as previously thought. In fact, the results of the present study demonstrate that Nutribullet processing a combination of fruits favorably flattens the postprandial glycemic response which is in conflict with the current recommendations for diabetics to avoid fruit smoothies.

As mentioned earlier, these recommendations are formed on the assumption that the majority of fibre in fruit juice and smoothies has either been removed or broken down. Although there is substantial evidence supporting the link between the consumption of fruit juice and the increased risk of T2DM (Muraki et al, 2013; Bolton et al, 1981; Haber et al, 1977), there appears to be a sparse amount of research investigating the effects of <https://assignbuster.com/effects-of-nutribullet-processing-on-glycemic-response/>

domestically blending fruits on glucose metabolism. Although, there is one study to our knowledge that has investigated the impact of whole fruit, fibre-disrupted purée and fruit juice (Haber et al, 1977). The authors reported that plasma glucose rose to similar levels after the consumption all three meals. However, they suggested the removal of fibre from food or the physical disruption of fibre, could lead to slightly higher postprandial glycemic responses. Indeed the cellular structure of fruit is important and potentially explains the results of the present study because unlike fruit juice, the fibre was not removed during the Nutribullet processing. Interestingly, evidence from a recent investigation showed that commercial smoothies which have gone through a homogenization process still contained high concentrations of intact fruit cells (Chu et al, 2017). However, we must appreciate that the process of homogenization is completely different to domestic food processing and therefore, it could be argued that perhaps domestic processing would elicit different outcomes with regards to fibre content. Although a recent study reported that the concentrations of insoluble and soluble fibre were the same in both domestically blended mango fruit and high hydrostatic pressurized mango (Elizondo-Montemayor et al, 2015). Therefore, this evidence signifies that the processing of fruits, with a domestic blender does not completely breakdown the fibre. This may go on to explain why the present study did not observe a sharp peak in blood glucose following the consumption of Nutribullet treatments, in comparison to studies which have observed postprandial hyperglycemia due to the consumption of fruit juice where the fibre is absent (Bolton et al, 1981;).

Although the results of the present study may be in part attributable to the presence of dietary fibre within the treatments, several other parameters

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have also been identified to affect the absorption of glucose. These parameters include the viscosity of the fruit and other properties of fibre, such as solubility and swelling capacity.

Effects of fibre on carbohydrate absorption

Fibre can be classified as either soluble or insoluble, characterized by how they react in aqueous solutions. Insoluble fibre includes lignin, cellulose and many hemicelluloses. These fibres make up the cellular-wall structure of fruits and vegetables. When consumed together with foods, these fibres behave as bulking agents and also increase intestinal transit time. Water-soluble fibre comprises hemicelluloses, and many polysaccharides, such as pectin. These fibres are characterized by their high water-holding capacity, also several of them are highly viscous in solution (Wursch et al, 1997).

Pectins are constituents of the primary cell wall and intercellular layer of plant cells. They are insoluble in unripe fruit, yet become more water-soluble as the fruit ripens. Lastly, they have large water-holding capacity and form gels in aqueous solutions.

Within the scientific community, it has been acknowledged that the presence of certain dietary fibres influences the digestion and absorption of CHO within the small intestine, resulting in a reduced and levelled off glycemic response. Importantly, this effect has been shown in both healthy and T2DM subjects (Jenkins et al, 2002; Anderson et al, 1994). It has widely been reported that viscous soluble fibre are most effective in improving glycemic control by reducing the postprandial glycemic response, in comparison to insoluble fibres (Jenkins et al, 1978; Elizondo-Montemayor et al, 2015). In

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contrast, it has also been established that when the viscosity of fibre in several products has been reduced through varied processing techniques then the reduction in blood glucose peak is attenuated (Wursch et al, 1997), signifying that both the solubility and viscosity of the fibre is directly linked to the attenuation of blood glucose. Due to the growing pool of scientific evidence linking the consumption soluble fibre with a flattened glycaemic response, several theories have been developed to explain what mechanisms in the small intestine may be causing the modulation of the glycaemic response.

One mechanism suggested is a delayed rate of gastric emptying. It is thought that due to the water-holding capacity of soluble fibre, a resulting delayed gastric emptying and transit time through the small intestine occurs, thereby resulting in a reduced rate of CHO absorption (Benini et al, 1995; Cherbut et al, 1995; Ou et al, 2001). Another proposed mechanism is that the ingestion of soluble fibre increases the viscosity in the small intestine resulting in a reduced mixing effect of peristalsis, thus reducing the digestion of CHO by pancreatic alpha-amylase and in turn causing a delayed diffusion of CHO to the intestinal mucosa (Cherbut et al, 1994; Ou et al, 2001). Lastly, it has also been proposed that the capacity of dietary fibre to bind to glucose may reduce the concentration of available glucose in the small intestine, resulting in reduced digestion and absorption of glucose (Ou et al, 2001).

Considering all this, a theory has been developed to further explain the results observed in the present study for the Nutribullet mixed fruit treatment. The theory is that the banana used within the mixed fruit

treatment is potentially the main fruit influencing the postprandial glycaemic response/
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responses. As previously mentioned, the ripeness of fruits is a major influencing factor on the concentrations of soluble and insoluble fibre. Recall from the methodology in the present study that all of the fruit was freshly purchased within days of the appropriate trial. Therefore, it is highly probable that the banana included in the mixed fruit trial was unripe as they were refrigerated for no more than 2 days. This theory is based on the evidence that unripe or less-ripe bananas contain higher concentrations of resistant starch, in comparison to over-ripe bananas. Resistant starch has been found to be more slowly digested in humans by alpha-amylase thereby causing a flattened glycemic response due to the reduced availability of glucose (Wolever et al, 1990; Hermansen et al, 1992). From all of this information we have established that dietary fibre is still present in fruits which have been domestically blended, also we have discussed some of the mechanisms potentially causing the effects fibre has on glycemic response. The next question at hand is whether Nutribullet processing effects the sugar content of fruit. It has been proposed that foods containing

Effects of Nutribullet processing on the composition of mango and mixed fruit carbohydrates

The content of simple sugars was lower per portion of mango (11. 8g) and mixed fruits (15. 7g) after Nutribullet processing, compared to whole mango (16. 5g) and whole mixed fruits (24. 9) (Table 3). Recall for the methodology in the present study that we calculated specific servings of each fruit to give 25g of sugar per serving among the whole fruit and Nutribullet treatments.

Due to this it was hypothesized that HPLC analysis would reveal that the sugar content of the whole fruit treatments would be similar, if not lower, <https://assignbuster.com/effects-of-nutribullet-processing-on-glycemic-response/>

compared to the sugar content of the Nutribullet treatments. Previous work has suggested that processing fruits, through homogenization, can cause losses in cell integrity, thus resulting in the release of simple sugars from compartmentalized structures and non-covalent links (Elizondo-Montemayor et al, 2015). On the contrary, this was not observed in the present study.

When comparing the total sugar content of both mango treatments to the observed postprandial glycaemic responses (Figure 1), there is a discrepancy where the extrapolated IAUC for both mango treatments do not correlate with the sugar content revealed through HPLC analysis. For example, from figure 1 we can see that both mango treatments had a very similar postprandial glycaemic response, yet HPLC analysis would suggest that the whole mango treatment should have had a higher glycaemic response.

Although this was not the case, signifying that errors in the HPLC methodology are potentially causing these results. For example, upon completion of the HPLC testing, it was regrettably found that several tubes containing various mango treatments still had remaining supernatant within them. This of course would explain the varied sugar content between the mango treatments and reflects that the investigators had varied pipetting skills.

Regarding the mixed fruit HPLC results, the total sugar content of both mixed fruit treatments seem to correlate well with the postprandial glycaemic responses (Figure 1). In addition, the mixed fruit Nutribullet contained half the sugar content compared to the whole fruit treatment. As discussed earlier, the potential mechanisms associated soluble fibre may explain why the Nutribullet treatment revealed to have a lower sugar content. For <https://assignbuster.com/effects-of-nutribullet-processing-on-glycaemic-response/>

example, the fibre may have bound to the glucose molecules reducing the available glucose in the small intestine, thus resulting in the attenuation of postprandial glycemic response. An in vitro digestion model, designed to mimic the in vivo situation, was able to determine the glucose content within supernatant by mixing 1g of resistant starch or soluble fibre with 100ml of glucose solution, then incubating the mixture in a water bath (37°C) for 6 hours, followed by centrifuging (Ou et al, 2001). The authors reported that the solutions which had added fibre contained less glucose within the supernatant, signifying that the fibre had binding potential to glucose.

On the other hand, it is important to consider that the HPLC results for the mixed fruit treatments may also be subject to errors within the methodology. For example, looking at Table 4, there is high relative deviation amongst the whole fruit samples, yet not amongst the Nutribullet samples. This indicates that there was low precision during the measurement of whole fruit samples. Again, perhaps due to the low level of skill among the investigators with regards to the pipetting, syringing and filtration of supernatant. Considering all of these limitations, the results obtained from HPLC analysis provide little relevance and impact to the present study.

Practical Implications of the results

The fact that both the whole fruit and Nutribullet treatments elicited a low GI and specifically that the mixed fruit Nutribullet treatment showed a significantly lower GI (figure 2) has important clinical implications for both healthy and T2DM subjects. A relatively recent Cochrane review which was based on 11 randomized controlled trials, reported that glycemic control in

T2DM subjects was improved significantly following a low GI diet, compared to those on a high GI diet (Thomas et al, 2009). In addition, a low GI diet elicited significant reductions in glycated hemoglobin A1c (0.5%) which are comparable to reductions usually found through medications for recently diagnosed T2DM patients (Holman, 1995; Holman, 1999). Furthermore, improvements in A1c of this size have been linked with the reduced risk of diabetes-related microvascular complications, such as retinopathy (Stratton, 2000). With regards to healthy subjects, diets containing low GI foods have been associated with reductions in body weight, improvements in lipid profile and a decreased risk of T2DM and cardiovascular disease (Jenkins et al, 2011; Barclay et al, 2008; Van Dam et al, 2000). Overall, as the Nutribullet does not appear increase their GI of commonly eaten fruits, both healthy and T2DM subjects could potentially benefit from this method of food preparation by improving glycemic control. Although as the results from the present study are novel, more research is needed before any conclusions can be drawn with regards to the safety and effectiveness of recommending that diabetics can consume fruit smoothies.

Study limitations

There are some limitations within the methodology of the present study that should be mentioned. Firstly, the present study employed only one reference trial. Recommendations are that the reference food (glucose) trial should be repeated at least once to minimise the variation of mean GI values (Wolever et al, 1991, 2002). For example, a simulation study carried out by Wolever et al (2003) found that the margin of error of the estimation of mean GI was reduced significantly from one to two reference measurements. Secondly, <https://assignbuster.com/effects-of-nutribullet-processing-on-glycemic-response/>

we were unable to enforce a strict standardization of diet and physical activity 24 hours prior to the test days which may reduce the reproducibility of the results. An ideal example would be that the subjects consumed a meal of their choice prior to the overnight fast and then would have been required to repeat that same meal before each trial. Thirdly, the results may be subject to selection bias as the participants included in the mixed fruit trials were also the investigators of the study and randomization was not used. In addition, due to the 10% drop out rate, it is possible that the degree of statistical power and precision was reduced as recommendations are that glycemic trials include a minimum of 10 participants (Brouns et al, 2005). Although, several strengths include the appropriate use of a repeated measures design which ensures less individual differences and allows the inclusion of fewer participants. Another strength is that the protocol closely followed evidence-based recommendations.

Conclusion

In conclusion, our results indicate the consumption of a variety of fruits including banana, mango, passion fruit, kiwi, raspberry and pineapple have a low GI and that processing these fruits with a Nutribullet generated further benefits, such as a significantly lower GI and a more favorable glycemic response. A higher proportion of the subjects presented a low GI for both of the Nutribullet treatments. These results are in conflict with current recommendations to restrict or avoid fruit smoothies. However, much evidence has indicated that the fibre content of fruit is still present after domestic and commercial processing treatments. More so, the evidence suggests that the presence of fibre within the processed fruit is still

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potentially having several beneficial effects on the postprandial glycemic response, such as slowing gastric emptying and reducing the amount of available glucose through binding mechanisms. These results could potentially have clinical implications for healthy and T2DM subjects who include these fruits in their diet. However, more research is needed 1. to determine if these effects are reproducible and 2. to determine the safety of diabetics consuming different fruit treatments produced by Nutribullet and/or other domestic appliances. Future research should further investigate the potential mechanisms involved with Nutribullet blending and how they are causing an altered glycemic response.