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Glycemic potential of Philippine grains during co-digestion with bignay [*Antidesma bunius* (L.) Spreng] pomace: an *in vitro* study

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Abstract

There has been increased demand for functional foods nowadays as people move towards a healthier lifestyle. Underutilized fruits, such as bignay [*Antidesma bunius* (L.) Spreng], are currently being investigated because of their high amounts of bioactive substances with health-promoting effects, particularly in addressing non-communicable diseases such as obesity and diabetes mellitus. Hence, this study evaluated the effect of bignay pomace on the estimated glycemic index (eGI) when co-digested with locally consumed grains. Results showed that upon addition of 1% freeze-dried bignay pomace, significant reductions in the estimated glycemic index [eGI] (7–17%) and hydrolysis index (15–32%) occurred during the two-stage simulated *in vitro* digestion of rice, *adlai*, white corn grits (WCG), 50:50 rice: *adlai* mix, and 70:30 rice: WCG mix. Further analysis revealed that the total dietary fiber and resistant starch contents in the grains affected the eGI of the grains, such that the amounts present retarded the rate of starch digestion. Bignay pomace significantly lowered the rate of the *in vitro* digestion of local grains, suggesting its potential to improve glycemic index. The study serves as relevant baseline data for the possible valorization of bignay pomace as a food supplement for the prevention of non-communicable diseases.

1. Introduction

Over the years, it has been a challenge to promote a diverse diet among populations across the world. With rice as one of the major sources of carbohydrates in Asia, there is a pressing need to monitor the digestibility of white rice. This can serve as an intervention tool in the management and prevention of diabetes and other nutrition-related chronic diseases (Argyri *et al*., 2016). Rice is known as a major contributor to the glycemic load of rice-eating populations due to its high estimated glycemic index (eGI) (Hu *et al*., 2012). Hence, it is encouraged to consume other nutritious crops that can still cater to one's carbohydrate requirements. Alternative grains are being promoted for their low GI value and thus their ability to retard spikes in postprandial blood glucose levels. White corn grits (Nagares *et al*., 2010) and *adlai* (Mamucod *et al*., 2020) or Job's tears are two crops that have been identified as potential rice substitutes. To make them more appealing to consumers, researchers have developed suitable composites of these grains with rice that are as acceptable as pure rice (Mamucod *et al*., 2020; UP Media and Public Relations Office, 2018) However, research studies on these two rice substitutes remain scarce. To date, limited data are available on various *in vitro* studies evaluating the starch digestibility of *adlai*, white corn grits, and their rice composites.

In vitro starch digestibility studies are vital in predicting and controlling glucose breakdown and absorption, thereby assisting in regulating postprandial blood glucose levels. Recent studies have shown that essential phytochemicals can reduce the risk of cardiovascular disease, type 2 diabetes, and cancers (Delshad Aghdam *et al*., 2021; Ramírez-Alarcón *et al*., 2021). Particularly, phenolic compounds were observed to reduce the risk of diabetes because of their inhibitory activity against α-glucosidase and pancreatic α-amylase, which are key enzymes in starch degradation (Ranilla *et al*., 2010). Therefore, it is important to explore other food crops that, when combined with staple foods, can

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reduce the overall glycemic impact and minimize the risk of type 2 diabetes.

Bignay [*Antidesma bunius* (L.) Spreng] is a fruit widespread in the Philippines but is also found in the lower Himalayas in India, Ceylon, Southeast Asia, and northern Australia (Belmi *et al*., 2014). It is reported to have potential health benefits and significant biological activities (Butkhup and Samappito, 2008; Lizardo *et al*., 2015; Crieta *et al*., 2021; Sartagoda *et al*., 2021). Recent toxicity reports deemed the fruit safe for consumption in mice at a maximum dose of 2000 mg/kg (Estacio *et al*., 2020; Muñoz *et al*., 2021). Usually, its fruits are processed into other food products such as juice, concentrates, and wine. Winemaking involves pulping the fruit and separating the flesh from the skin and seeds (Belina-Aldemita *et al*., 2013). The flesh is pureed and undergoes fermentation to produce wine. While the skin, seeds, and some of the leftover pulp, known as pomace, are discarded. The flesh and seeds of bignay contain high amounts of antioxidants especially in its fully ripe stage (Castillo-Israel *et al*., 2020), the stage used for bignay winemaking. Moreover, since pomace consists of peel and seeds, dietary fiber is considered its main component (Saura-Calixto, 2011). This is of great advantage because dietary fibers increase the viscosity of the food which in turn delays the accessibility of starch granules to digestive enzymes (Angioloni and Collar, 2011). Both components (i.e., phenolic compounds and dietary fiber) of bignay pomace could retard the digestibility of starch, positively affecting postprandial blood glucose levels (Thorne *et al*., 1983).

Hence, this study aimed to determine the effects of bignay pomace on the *in vitro* starch digestibility of commonly consumed grains in the Philippines. The results may be useful in the development of bignay pomace as a functional food ingredient with health-promoting effects. In addition, the valorization of bignay pomace can alleviate the problem of food waste in the manufacturing industry, which is crucial in today's changing and developing market.

2. Materials and methods

2.1 Materials

White corn grits (IPB Var 6 Corn Grits, High Quality Protein Maize) [WCG] were obtained from the Institute of Plant Breeding (IPB), University of the Philippines Los Baños, Laguna, Philippines. Milled rice (NSIC Rc160) and *adlai* (*Ginampay* variety) were obtained from the Philippine Rice Research Institute (PhilRice), Maligaya, Nueva Ecija, Philippines. In addition to rice, *adlai*, and WCG, two rice composites were made from these grains: (1) 50:50 rice: *adlai* and (2) 70:30 rice: WCG. The grain samples were vacuum-sealed and stored at -20°C until use. A portion of the samples were also ground to pass a 20-mesh sieve and subjected to the same storage conditions. On the other hand, bignay [*Antidesma bunius* (L.) Spreng] pomace was collected after pulping fully ripe bignay fruit prior to winemaking. The pomace was freeze-dried and ground to pass a 20-mesh sieve. Powdered pomace was stored at -20°C prior to analysis.

Reagents used for total starch determination namely, amyloglucosidase (3260 U/mL in soluble starch) and glucose oxidase/peroxidase (GOPOD) reagent were purchased from Megazyme Ltd. (Ireland). Pepsin (porcine stomach mucosa, 1:1000) and pancreatin (163–00142) were obtained from Fujifilm Wako Pure Chemical Corp. (Japan). Invertase was purchased from Sigma-Aldrich Ltd. (USA). Other chemicals used in the study were analytical grade.

2.2 Sample preparation

Uncooked grains were used for non-resistant and resistant starch analyses. For simulated gastrointestinal *in vitro* digestion, grain samples were cooked in a conventional rice cooker until the absence of a white core was achieved, which is considered fully cooked. The cooked grains were homogenized using a household blender (Sonifer Hand Blender SF-8054, China) on a high setting for 1 min to produce a slurry. The moisture content (MC) of the slurry was determined using the standard official methods of the Association of Official Analytical Collaboration (AOAC) International (2005).

2.3 Chemical composition of bignay pomace and grain samples

The proximate composition of the uncooked rice grains and freeze-dried bignay pomace was carried out following the standard AOAC Official Methods for Analysis (AOAC, 2005). Non-resistant starch (NRS), resistant starch (RS), insoluble dietary fiber (IDF), and soluble dietary fiber (SDF) of uncooked grain samples were determined according to the procedures of the Megazyme assay kits (Megazyme Ltd., Ireland).

2.4 Simulated in vitro gastrointestinal digestion

The study employed a two-stage *in vitro* gastrointestinal digestion method (Dartois *et al*., 2010) with modifications (Reginio *et al*., 2020). Two sets of runs were performed for each grain sample: (1) without bignay pomace and (2) with 1% bignay pomace. The reference food, white bread, was also analyzed similarly. A total of 170 g of grain slurry and water mixture (to contain 4% starch) were prepared and added into a 500 mL double-jacketed glass reactor with continuous

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stirring. The reactors were connected to a circulating water bath to maintain a temperature of 37±1°C. To simulate gastric digestion, the pH was adjusted to pH 2, then the simulated gastric fluid (SGF), containing pepsin and appropriate molar concentrations of HCl, was added to reach a pH of 1.20±0.02. After 30 mins, the pH was increased to 6.0±0.1 by adding different concentrations of NaOH. Then, small intestinal fluid, containing pancreatin, invertase, and amyloglucosidase, was added to reach a pH of 6.8±0.02 to simulate the small intestinal digestion phase. Supernatants of 1 mL were collected for D–glucose analysis at 0 and 30 mins in the gastric phase, and at 5, 20, 60, 120, 180 and 240 mins after the start of the small intestinal phase. The aliquots were mixed with 95% ethanol to stop the enzymatic reactions.

2.5 Glucose measurement and kinetics of starch hydrolysis

Glucose content was determined using a D-glucose assay kit (GOPOD Format K-GLUK 08/18, Megazyme International). Supernatants from the *in vitro* digestion were centrifuged at 3500 rpm for 20 mins. A total of 50 µL of the supernatant was mixed with 0.25 mL of invertase/amyloglucosidase in potassium acetate buffer (pH 5.2) to break down sucrose into glucose units, and incubated at 37°C for 10 mins. Then, 0.1 mL of the resulting solution was combined with 3 mL GOPOD solution and incubated at 50°C for 20 mins. The absorbance was measured at 510 nm using a UV-VIS 1900i spectrophotometer (Shimadzu Corp., Japan).

2.6 Statistical analysis

All chemical analyses were performed in triplicates except for total dietary fiber wherein duplicates were used. Results were expressed as mean ± standard deviation (SD). Data were subjected to one-way analysis of variance (ANOVA) and Tukey's Honest Significant Difference (HSD) to compare means within treatment groups at 0.05 level of significance. Paired t-test was used to compare differences in the means of the same grains across treatment groups. The ANOVA, paired t-tests, and correlation analyses were performed using Minitab for Windows version 19.2020.1 (Minitab LLC, USA). For *in vitro* digestion, the kinetic constant and hydrolysis index were computed by non-linear regression (curve fit) using GraphPad Prism version 9.4.1 for Windows (GraphPad Software, USA).

3. Results and discussion

The impact of bignay pomace on the estimated glycemic index of local grains was determined using a two-stage *in vitro* digestion consisting of gastric and intestinal phases. The proximate composition, total dietary fiber (TDF), insoluble dietary fiber (IDF), soluble dietary fiber (SDF) contents of the uncooked grains were analyzed, as well as the resistant starch (RS), non-resistant starch (NRS), and total starch (TS) content to determine their possible effect on the rate of starch hydrolysis in the grain samples. The freeze-dried bignay pomace was also subjected to preliminary characterization wherein its proximate composition, TDF, and bioactive profile (Zubia *et al*., 2023) were determined.

3.1 Characterization of freeze-dried bignay pomace

In terms of proximate composition, crude fiber (43.17±1.10 g/100 g DW) was the predominant component of freeze-dried bignay pomace, followed by carbohydrates represented by nitrogen-free extract [NFE] (32.27±1.8 g/100 g DW), crude protein (7.88±0.29 g/100 g DW), crude ash (6.23±0.01 g/100 g DW), moisture (6.09±0.27 g/100 g DW), and crude fat (4.36±0.26 g/100 g DW). This confirms related literature where dried berry pomace contains 5–6% moisture and fiber is the major component (Struck *et al*., 2016). Unlike fresh bignay fruits wherein it is comprised mainly of carbohydrates (Islary *et al*., 2017), the present study suggests that dietary fiber is the main component of bignay pomace. This holds true for other pomace from well-known berries such as blackcurrant, redcurrant, and chokeberry (Reißner *et al*., 2019).

The high crude fiber content was further confirmed by the considerably high TDF content of bignay pomace (74.84±0.70 g/100 g DW). Specifically, it contains 69.25±1.28 g/100 g DW IDF and 5.59±0.59 g/100 g DW SDF. Fruit pomace consists of cell wall compounds, stems, and seeds making it high in dietary fiber (Quiles *et al*., 2018). Dietary fiber pertains to carbohydrate polymers which are not hydrolyzed in the human body's small intestine (Viebke *et al*., 2014). Pectins, gums, inulin-type fructans, and some hemicelluloses are some examples of SDF known for their benefits on serum lipids, while IDF aids in laxation (Quiles *et al*., 2018). Interestingly, the TDF of bignay was similar to that of cranberry (72.67±1.55 g/100 g DW) and lingonberry (73.85±0.83 g/100 g DW) and higher compared to sea buckthorn (63.61±1.64 g/100 g DW) and black currant (49.24±0.95 g/100 g DW). The same trend goes for their respective IDF and SDF contents (Jurevičiūte *et al*., 2022).

3.2 Chemical composition of rice and rice composites

Table 1 summarizes the proximate composition of the different uncooked rice grains. The moisture content of grains was within the recommended moisture content of <13% for safe storage (Ziegler *et al*., 2021). Notably, the protein content of *adlai* and its composite with rice was significantly higher compared to the other grain samples. This corroborates with existing literature stating that *adlai* has a higher protein content compared to rice and corn (Magpantay *et al*., 2021). No clear trend was observed for crude ash of all the samples. Amongst all the grains investigated, *adlai* obtained the lowest carbohydrate content and was comparable to its 50:50 composite with rice.

The total starch and dietary fiber content of the samples is shown in Table 2. TS did not vary between the samples except for WCG. Conversely, RS content varied amongst grains with WCG having the highest value. These were similar to the other findings (Purificacion *et al*., 2018) where IPB Var 6 WCG had a total starch content of 73.15±0.35%. Likewise, TDF and IDF varied between the grain samples. The values were also consistent with the crude fiber determined by proximate analysis in this study. In both analyses, WCG had the highest fiber content while rice had the lowest.

3.3 In vitro starch digestibility and glycemic index of cooked rice and rice composites

The *in vitro* starch hydrolysis curves can be used to interpret and observe *in vitro* starch digestibility patterns. This was obtained by measuring the free glucose released during the 4 hrs simulated digestion of cooked grains at different time points as shown in Figure 1. *In vitro* starch hydrolysis index (HI) of cooked grains were computed based on the area under the curve (AUC) of the samples' starch hydrolysis curve against white bread, which was used as the reference food.

Cooked rice had the highest percentage of starch hydrolysis and showed a similar trend to white bread at almost every time point, with the plateau-forming part of the curve starting at 180 mins. A*dlai* and WCG exhibited patterns of steadily increasing the percentage of starch hydrolysis; however, a slight increase was displayed by *adlai* at the same time point. On the other hand, the 50:50 rice: *adlai* composite had a steeper slope compared to white bread, which indicates continuous hydrolysis of starch in the sample. The starch hydrolysis of all samples began at the 5th min of the small intestinal phase, as indicated by the sudden increase in the percentage of starch hydrolysis. This can be attributed to the action of pancreatic α-amylase, which can hydrolyze starch to its basic units of maltose and glucose (Hur *et al*., 2011).

A first-order equation model was used to determine the kinetics of starch hydrolysis and the estimated glycemic index (eGI) of the samples after *in vitro* digestion (Table 3). Among the grain samples, rice had the highest eGI but was also statistically comparable to WCG and 70:30 rice: WCG composite. Interestingly, the addition of 1% of freeze-dried bignay pomace significantly lowered the eGI and HI of all the grain samples. The percentage of decrease of eGI elicited by the addition of pomace ranged from 7–17%. The highest decrease in eGI was observed in rice and the lowest was observed in 50:50 rice: *adlai* mix, suggesting that bignay pomace can more effectively regulate postprandial glucose levels of rice eaters. Meanwhile, HI decreased at a range of 15–32% for all the samples upon co-digestion

Table 1. Proximate composition of uncooked grain samples.

Sample	Moisture (%)	Crude ash (%)	Crude protein (%)	Crude fat (%)	Crude fiber (%)	NFE (%)
Rice	11.96±0.18^{a}	0.68±0.02^{a}	8.29±0.52^{a}	0.80±0.04^{a}	n.d.	78.27±0.42^{a}
Adlai	11.73±0.01^{a}	0.25±0.02^{b}	15.05±0.86^{b}	0.57±0.03^{b}	n.d.	72.33±1.06^{b}
White corn grits	11.26±0.04^{c}	0.21±0.00^{b}	10.13±0.19^{a}	0.32±0.02^{c}	0.26±0.02^{a}	77.81±0.70^{a}
50:50 Rice: *Adlai*	11.67±0.04^{a}	0.52±0.03^{c}	13.04±1.13^{b}	0.48±0.05^{b}	0.13±0.01^{b}	74.15±1.22^{b}
70:30 Rice: WCG	11.74±0.03^{a}	0.42±0.01^{d}	8.77±0.12^{a}	0.84±0.06^{a}	0.12±0.00^{b}	78.22±0.88^{a}

Values are presented as mean±SD. Values with different superscripts within the same column are statistically significantly different at $p<0.05$ using Tukey's HSD test. Results expressed as percentage values calculated as dry basis except for moisture content. NFE: Nitrogen-free extract which estimates total carbohydrates; calculated by subtracting the sum of all the components from 100%, n.d.: not detected.

Table 2. Total starch (%) and dietary fiber (%) contents of uncooked grain samples.

Sample	RS (%)	NRS (%)	TS (%)	IDF (%)	SDF (%)	TDF (%)
Rice	0.25±0.02^{a}	83.12 ± 1.52^{a}	83.37±1.52^{a}	2.13±0.27^{a}	0.51±0.13^{a}	2.64±0.40^{a}
Adlai	2.49±0.27^{b}	79.83±0.51^{b}	82.32±0.53^{a}	6.92±2.12^{b}	0.92±0.14^{a}	7.84±2.26^{b}
White Corn Grits	11.31±0.63^{c}	67.02±1.98^{c}	78.33±2.61^{b}	9.51±0.44^{b}	0.54±0.30^{a}	10.05±0.15^{b}
50:50 Rice: *Adlai*	1.76± 0.16^{b}	80.43±0.22^{ab}	82.19±0.32^{a}	5.55±0.51^{ab}	0.63±0.16^{a}	6.18±0.67^{ab}
70:30 Rice: WCG	4.29±0.18^{d}	77.95±0.26^{b}	82.24±0.41^{a}	6.84±0.51^{b}	0.48±0.06^{a}	7.32±0.45^{b}

Values are presented as mean±SD as dry basis. Values with different superscripts within the same column are statistically significantly different at $p<0.05$ using Tukey's HSD test. RS: resistant starch, NRS: non-resistant starch, TS: total starch, IDF: insoluble dietary fiber, SDF: soluble dietary fiber, TDF: total dietary fiber

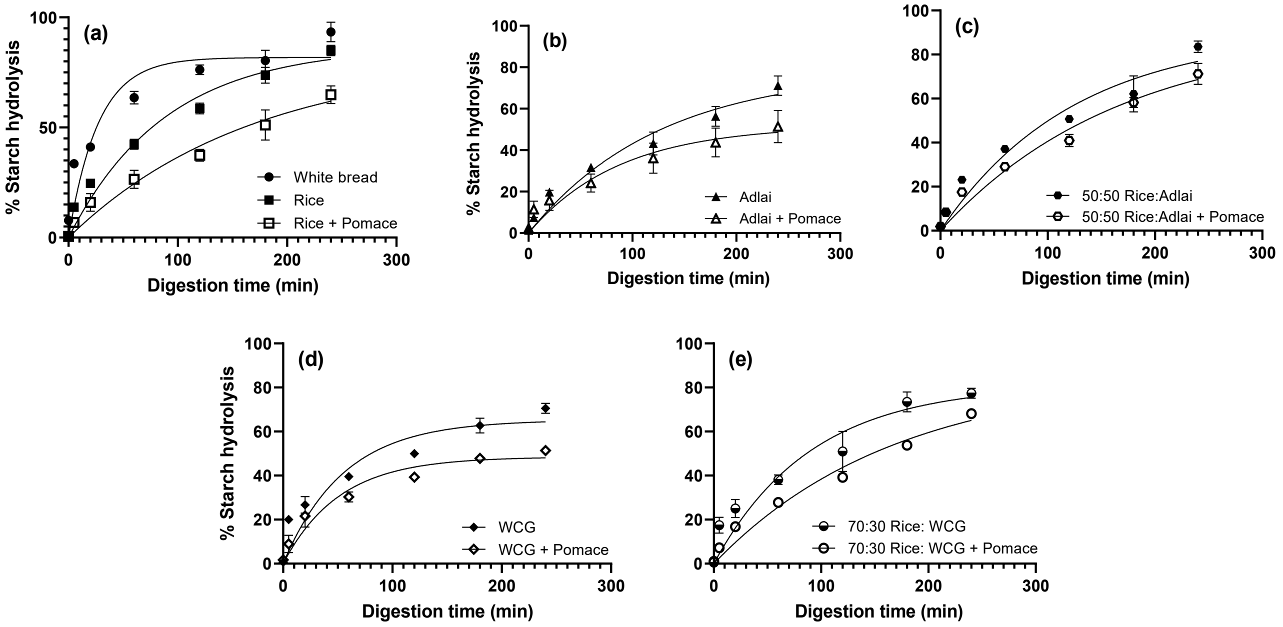

Figure 1. Changes in starch hydrolysis (%) during *in vitro* digestion of (a) rice; (b) *adlai*; (c) 50:50 rice: *adlai*; (d) white corn grits (WCG); and (d) 70:30 rice: WCG, with and without the addition of 1% bignay pomace.

Table 3. Equilibrium concentration (C∞), kinetic constant (k), hydrolysis index (HI), and estimated glycemic index (eGI) of cooked grains with and without bignay pomace.

Sample	C∞ (%)	k (min^{-1}) × 10^{-2}	HI (%)	eGI (%)
Without pomace				
Rice	86.71±2.99^{a}	1.13±0.02^{a}	77.89±3.02^{a}	82.47±1.66^{a}
Adlai	78.42±8.18^{ab}	0.80±0.06^{a}	59.81±4.17^{c}	71.57±3.96^{b}
White corn grits	66.55±3.98^{b}	1.55±0.24^{b}	66.63±3.27^{bc}	76.29±1.80^{ab}
50:50 Rice: *Adlai*	89.66±6.26^{a}	0.81±0.03^{a}	68.82±4.01^{bc}	77.49±2.20^{b}
70:30 Rice: WCG	82.35±2.37^{a}	1.11±0.24^{a}	72.88±5.91^{ab}	79.72±3.24^{a}
With pomace				
Rice	83.18±7.52^{a*}	0.60±0.18^{a}	52.65±4.88^{a}	68.62±2.68^{a}
Adlai	52.41±4.96^{b}	1.14±0.28^{b*}	46.96±8.50^{a}	65.49±4.67^{a}
White corn grits	48.63±3.02^{b}	2.33±1.31^{b*}	52.04±2.09^{a}	68.28±1.15^{a}
50:50 Rice: *Adlai*	90.09±5.27^{a*}	0.60±0.01^{a}	58.64±3.37^{a}	71.90±1.85^{a}
70:30 Rice: WCG	85.60±2.26^{a*}	0.60±0.00^{a*}	55.40±1.46^{b}	70.12±0.80^{b}

Values are presented as mean±SD. Values with different superscripts within the same column are statistically significantly different at $p<0.05$ using Tukey's HSD test.

*Indicates no significant difference at $p<0.05$ compared to their "without pomace" counterparts using paired t-test

with bignay pomace. Both HI and eGI followed the order: rice > 70:30 rice: WCG > WCG > *adlai* > 50:50 rice: *adlai*, in terms of the largest decrease. The equilibrium concentration (C∞) of *adlai* and WCG, both treated with 1% bignay pomace, was significantly lower compared to the no pomace counterparts. This means that the percentage of starch hydrolyzed in *adlai* and WCG after 180 mins was lower when added with 1% bignay pomace. The kinetic constant (k), which indicates the rate of hydrolysis, were generally significantly higher in the grains without bignay pomace than those samples with pomace, except for *adlai* and WCG. Taken together, data suggests that rice is more rapidly hydrolyzed than *adlai* and WCG. Moreover, the lower k values of the grain samples supplemented with bignay pomace also indicate that components from bignay pomace might play a significant role in hindering enzyme action, subsequently decreasing the rate of hydrolysis.

The GI-lowering activity of bignay pomace may be attributed to its high amounts of bioactive substances. Based on preliminary experiments, the total phenolic, anthocyanin, and flavonoid contents of bignay pomace (Zubia *et al.*, 2023) were higher than freeze-dried bignay fruit flesh (Castillo-Israel *et al.*, 2020). Moreover, compared to other berry pomace such as bilberry, blackberry, strawberry, and raspberry, bignay has higher levels of phenolics (Viebke *et al.*, 2014). Previous studies exploring the effects of blueberry and raspberry polyphenols on starch digestibility found that *in vitro* co-digestion of these berry extracts with white bread significantly reduced the rate and extent of starch digestion (Kan *et al*., 2020) by interfering with the digestive enzymes, α-amylase and/or α-glucosidase (Barrett *et al*., 2018), and the glucose transporter at the intestinal brush border (Takahama and Hirota, 2018). The covalent interactions of starch with polyphenols, specifically flavonoids, during cooking and in the stomach, alter the structure of starch reducing its availability as a substrate for the enzymes (Takahama and Hirota, 2018). Proanthocyanidins have also been demonstrated to inhibit these key digestive enzymes due to their high polymerization degree and many hydroxyl groups (Lavelli *et al*., 2015). Besides the presence of polyphenols in bignay pomace, other factors such as their concentration in the food, absorption, metabolism, bioaccessibility, and bioavailability can affect the glucose-lowering capacity of these compounds (de Paulo Farias *et al*., 2021).

Results from the present study also showed that generally, eGI lowers with higher TDF. During simulated *in vitro* digestion, the high dietary fiber of bignay pomace contributes by changing the physical and chemical properties of the starch system, such that the dietary fiber may have competed with the starch for the available water (Viebke *et al*., 2014), interfering with the starch digestion process. SDF can also increase matrix viscosity at the gastrointestinal level, resulting in the formation of a gel (Jia *et al*., 2020). It can also envelop starch grains, protecting them from the amylolytic activity of digestive enzymes, and delaying the release of free glucose, which results in a reduced glycemic response (Juvonen *et al*., 2009). This is supported by another study (Dartois *et al*., 2010), wherein the presence of guar gum inhibited the action of enzymes in the *in vitro* digestibility of starch.

Correlation analysis revealed that the SDF of the grains alone had a strong significant negative correlation with all the *in vitro* digestibility parameters, particularly with eGI (r = -0.9541) and $C\infty$ (r = -0.9580). With the addition of bignay pomace, the fiber content of the digesta containing the grains increased. It has been reported that fiber can compete with the starch granules for water adsorption, reducing starch gelatinization (Tolve *et al*., 2020). The action of ɑ-amylase and ɑ-glucosidase is also hindered. Similarly, RS had a strong significant negative correlation with k (r = -0.8722). It is well-known that the consumption of RS-containing foods reduces the rate of digestion. RS has an equivalent behavior to fiber which enables it to escape enzymatic digestion in the small intestine and is fermented in the large intestine (Ho and Wong, 2020). The correlation of RS with the degree of starch hydrolysis was also observed in a previous study (Shu *et al*., 2009), indicating that foods with high RS are of great value for eGI control. Thus, dietary fiber and starch present in the grains can also inhibit *in vitro* digestion and hydrolysis of starch to a certain extent, thereby reducing starch hydrolysis rates and eGI of grain samples.

4. Conclusion

This study evaluated the glycemic potential of rice, *adlai*, white corn grits, 50:50 rice: *adlai*, and 70:30 rice: WCG when co-digested with bignay pomace. The results of this study may be useful in the development of bignay pomace into food supplements that can be taken during the consumption of rice staples to retard spikes in postprandial blood glucose levels. Significant reductions were achieved in the estimated glycemic index and hydrolysis index of the cooked grain samples upon the addition of 1% bignay pomace. *In vivo* testing is suggested to support current findings and to determine the effects of bignay pomace in lowering the glycemic index of local grains in live subjects. This glucose-lowering effect of bignay pomace may be used in the prevention and management of metabolic diseases and thus can be used for pharmaceutical purposes.

Conflict of interest

The authors declare no competing interests.

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