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Research Article

Acacia gums and Adansonia digitata pulp Nutritional Value: Formulation Potential from Biotechnological Approach

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Abstract

Background: The human innate immune system (HIIs) prevents the host from being infected by pathogenic organisms, including viruses, bacteria, parasites, and fungi. This defense mechanism of the HIIs can be augmented by an increased metabolism level, which requires energy sources and substrates derived from food.

Aim: This pioneer study investigates the nutritional values (NVs) of an optimum blended formula (5:3:2 grams) of Acacia gums (AGs) (composed of *Acacia seyal* gum and *Acacia sengal* gum) and *Adansonia digitata* L pulp (ADLPs) respectively, to evaluate their NVs for supporting the HIIs of infected COVID-19 patients, especially those associated with metabolic syndrom (Met-S) diseases.

Methods: The study's main objective is to develop an optimal formula using a specific combination of AGs and ADLPs based on their NVs. The NVs, including moisture, ash, minerals, protein, amino acids (AAs), carbohydrates, sugars, prebiotic polysaccharides, energy, dietary fibers (DFs), and crude fibers, were investigated using Inductively Coupled Plasma-Optical Emission Spectroscopy (ICP-MS) and High-Performance Liquid Chromatography (HPLC).

Results: As a result, the mineral level of the (3in1) blend, which comprises (AGs and ADLPs), was significantly ($p \leq 0.05$) dominated by K(70.56±2.35), Ca(68.54±3.12), Na(31.4±4.8), Zn (19.19±2.10), Fe(19±0.14), Mg(16.60±4.8), Cu(15.12±1.81), P(11.50±2.50), and Se(0.037±0.005)g/100gDW. The (3in1) blend had a higher hydroxyproline content of 30.17g/100g for the (3in1) blend compared to the AGs (2in1) blend. The blended formula's total protein content was 3.34 ± 0.121% significantly ($p \leq 0.05$) higher. Moreover, carbohydrates (CHOs) were significantly ($p \leq 0.05$) higher in the (3in1) blend compared to the AGs (2in1) blend. The major reducing sugar constituents were arabinose (48.23 and 49.97g/100gDW) for the the (2in1) and (3in1) blend, respectively. Interestingly, the prebiotic polysaccharide was 88.61 ± 3.121 g/100gDW for the (3in1) blend, which is ($p \leq 0.05$) higher compared to 84.00 ± 2.15 g/100gDW for the AGs (2in1) blend. The energy value for the (3in1) blend was 350.12 ± 5.210 kcal/100g, significantly ($p \leq 0.05$) higher than the 340.67 ± 3.155 Kcal/100g for AGs. The dietary fibers (DFs) were 12.62 ± 2.10g/100gDW as insoluble dietary fibers (IDFs) and 87 ± 2.124g/100gDW as soluble dietary fibers (SDFs) for the (3in1) blend, which is significantly ($p \leq 0.05$) different compared to 1.865 ± 0.005g/100gDW of IDFs and 84 ± 30.45g/100gDW of SDFs for the AGs (2in1) blend.

Conclusion: Finally, we conclude that AGs with ADLPs have an effective molecular structure that may have strengthened HIIs against the Covid-19 pandemic. This suggests the potential beneficial use of AGs blended with ADLPs as a natural antiviral agent.

Keywords: Gum Arabic; Physico-Chemical Properties; Baobab; SARS-CoV-2; High-Performance Liquid Chromatography (HPLC) and ICP-MS

Abbreviations

AA: Amino Acids; ADLP: Adansonia Digitata L Pulp; AG: Acacia Seyal Gum; CCB: Calcium Channel Blocking; DFs: Dietary Fibers; DFA: Dietary Fatty Acids; EAA: Essential Amino Acids; HII: Human Innate Immune; HPLC: High-Performance Liquid Chromatography; IDF: Insoluble Dietary Fibers; MC: Moisture Content; NEAA: None Essential Amino Acids; NPF: Natural Prebiotics Formulations; NV: Nutritional Values; PF: Pulmonary Fibrosis; PP: Prebiotic Polysaccharides; PV: Proximate Values; SD: Standard Deviation; SDF: Soluble Dietary Fibers; TNF: Tumor Necrosis Factor

Introduction

The World Health Organization (WHO) on 30 January 2020 declared Covid-19 a national health emergency of international concern, and on 11 March 2020, declared the rapidly spreading outbreak of coronavirus a pandemic. Since December 19, 2021, about 445,096,612, including 5,998,301 deaths reported by the WHO, have been promptly confirmed [1]. To date, 180 countries worldwide have been affected by Covid-19 [1]. Despite the intense scientific efforts worldwide to solve the health challenge of Covid-19, no organic medication has significant clinical effects on the virus [2]. Therefore, other potentially beneficial technologies, drugs, or products should be investigated, including prebiotic-rich natural products.

Many food supplements, like prebiotics rich in vitamin D addition, may have naturally strengthened the clinical effects of people infected with Covid-19 [3]. These are, therefore, proposed to protect against Covid-19 [4]. Unfortunately, no specific food can protect people against this Covid-19 [5]. However, a balanced and healthy diet in terms of natural prebiotics formulations (NPFs) with AGs has been reported that helps support the human innate immune system (HIIs) of immuno-compromised patients and strengthen them [6]. Furthermore, it impacts on natural polyphenolic neuromodulatory and neuroprotective activities that serve as upregulated adenosine A2A receptor, modulated Alpha (TNF-α) tumor necrosis factor (TNF), interferon-gamma (IFN-γ), and cytokine production [7]. In particular, metabolic syndrome (Met-S) diseases can play a vital role in the immune response.

Met-S illnesses present clusters of lifelong problems, including excessive blood sugar, essential hypertension, excessive, excess body fat, aberrant cholesterol, or triglyceride, that coincide and elevate the elevated risk of heart disease, stroke, and uncontrolled diabetes [8]. Only one of these terms does not specify Met-S. All these circumstances, however, raise the chance of severe illnesses, including Covid-19. Thus, Covid-19 patients associated with Met-S highly recommend being under intensive care.

A short time ago, due to the pivotal role of AGs in several biological studies, the possible mechanism of formulated AGs had typically caused considerable interest in the scientific community. These comprehensive studies, therefore, showed that a continuous improvement in lipid metabolism using AGs, as reported by Evans., *et al*. [9], it has had a positive influence on many degenerative diseases, including kidney failure [10], patients with cardiovascular disease or metabolic risk [8], anti-inflammatory diseases [11], and anti-cancer agents [12]. Similar work has also used AGs on gastrointestinal diseases [13]. Therefore, in this field, a study uses NPFs, which are essential for the food and pharmaceutical industries.

The extensive literature currently reports on ADLPs for their prebiotic effect. Moreover, as an antioxidant, ADLPs undoubtedly possess various biological activities [14], it has rich in vitamins C and A [15], its positive effect on gastrointestinal conditions [16], as well as metabolic syndrome [17], it has also been reported. Therefore, a mix of AGs and ADLPs could produce new products based on FNPs to enhance the HIIs. The polyphenolic content (PPCs) of FNPs and their lipovitamins and the necessary vitamin C could make a difference due to the recognized variety of phytonutrient which undoubtedly produce a diverse effect on human health [18]. This breakthrough in health benefits expects leading to over 25,000 plant foods, notably FNPs [19]. Moreover, Sen., *et al*. [20] studied the action of FNPs as antioxidants to combat harmful free radicals that harm tissues in human bodies.

AGs like FNPs, antivirals, and other effects have therefore been highlighted in several comprehensive studies. Its leading role in untreatable infection with a specific Tapco virus [21] and its positive impact on plasmodium malaria virus therapy [22], and an immunoregulatory agent for patients with Covid-19 [6], was also confirmed. The AGs, therefore, promise massive benefits to vulnerable patients. Furthermore, these natural agents are remarkably useful in treating infected patients with Covid-19, as they treat latent viruses from various cell reservoirs, such as the brain and lymphoid organs [6]. Reformulating food to boost the immune system of a person is therefore essential.

Significantly, the glowing review of numerous prebiotic studies has amply confirmed that the human gastrointestinal tract sufficiently occupies more bacterial cells in the precisely exposed body

than other human cells [23]. Consequently, they had more biological advantages with food consumption to provide valuable information on the connection between regional selenium status and reported Covid-19 cases in China [23]. Accordingly, the proportionality of both Bifidus and lactic acid bacteria can be selectively increased by AGs. Additionally, several research groups have now studied the treatment of Covid-19 patients with gastrointestinal indications, including diarrhea and abdominal pain caused by a direct viral infection of the intestinal mucosa [24]. Thus, the impact of prebiotics on boosting IIS is exceptionally beneficial.

Inhibiting harmful bacteria of the intestine can progressively reduce asymptomatic infections due to intestinal microflora dysbiosis and toxin production. This can improve gastrointestinal symptoms by undoubtedly increasing the Covid-19 patient's IIS [25]. This is also important to improve the frequency of default and face character and reduce diarrhea by inhibiting the atrophy of intestinal mucosa [26]. These findings reinforce the importance of this study in promoting probiotics' importance as a possible supplement to improve the IIS of patients with Covid-19 and to modify antibiotics [26], Minimizing the potential for translocation of intestinal bacteria and gum-derived infections.

This historical study appropriately manages the ethnopharmacological application to boost patient's IIS with Met-S by voluntarily adopting a blended formula of AGs (an appropriate mix of *Acacia sengal* gum and *Acacia seyal* gum) and ADLPs powder. These organic plant materials appear to be beneficial as necessary adjuncts in adequately treating Covid-19 infected patients since they purge latent viruses from various cellular reservoirs, such as in the alive brain and lymphoid organs [27]**.** Therefore, the blended formula can provide a mechanism of action for immunization and detoxification.

Although AGs are frequently studied in the optimum combination of formulas mixed with other vegetable fruits rich in necessary vitamins C, D, and other essential phytonutrient, including ADLPs, they are as yet unexamined. This study proposes and adequately develops an optimal formula using a specific combination of AGs and ADLPs to assess its potential effectiveness in boosting asymptomatic Covid-19 patients' HIIs through molecular structure feeding. Previous studies on positively enhancing the IIS against Covid-19 focused on innovative NPFs products with various valuable resources like AGs and ADLPs. Instead, the standard method involved advanced analysis of molecular structures like valuable minerals, functional proteins, complex carbohydrates, prebiotic polysaccharides, efficient energy, and DFs responsible for combating the Covid-19 pandemic. An in-vivo study combined with a biplot questionnaire survey is accurately reported in part II of this comprehensive study in a separate article currently under reviewing at the time of this report.

Materials and Methods

Sample collection and preparation of the optimum formula

The base samples were *Acacia sengal* and *Acacia seyal* gums obtained from Blue Nile state (11°16′N 34°4′E) (Sudan) in the season of 2019/2020, and baobab pulp powder obtained from Sudan (11°16′N 34°4′E); Blue Nile state in the season of 2019/2020). For a comprehensive comparison, we developed three modified formulas (comparable samples), which consist precisely of the optimum formula (herein called blended 3in1), another specific formula carefully gathered blended 2:1, and the baseline ADLPs formula. The optimum formula (blended 3in1) typically consists of *Acacia sengal* and *Acacia seyal* gums and ADLPs blending. At the same time, the blended (2in1) consists of Prebio-T, which is carefully composed of *Acacia sengal* and *Acacia seyal* gums, whereas Prebio-M, which is naturally derived from *Acacia sengal* gum alone. All samples required cleaning from organic impurities such as bark and yielding sand. At that point, used samples were carefully selected randomly from the samples and divided into three parts. Each part was uniformly grained and sufficiently ground mechanically into a used powder using a USA standard, a testing sieve of 1.40mm (Fisher, Lenexa, Kansas, United States). Finally, a 5:3gm of AGs and 2gm of ADLPs were adequately introduced for further NVs analysis.

Evaluation of nutritional values of the optimum formula

Determination of moisture content

The moisture content was accurately determined following the Official Analytical Methods Association (AOAC) with slight modifications, as Horwitz and Latimer [28] described. The moisture content (MC) was dried in the oven using the STP/Chem/A04 method in-house based on AOAC's 16th edi.950.46. Firstly, empty crucibles were dried for 30 minutes in a Thermo Scientific Heraeus drying oven at 105°C and then weighed (M1) in a desiccator after cooling. Next, about 2g of the sample was precisely weighed (M2). In the drying oven at 105°C, the contents were dried for 5 hours, then cooled in the dryer before taking the third weight (M3). The Equation was used to calculate the loss percentage of the sample after drying [1]. The test was conducted in three replicates.

$$\text{Moisture\%} = (M3-M2)/M1\times100 \quad \text{..... (1)}$$

Where M1 is the weight of the empty crucible, M2 is the weight of the crucible and the raw sample, and M3 is the weight of the crucible and the dried sample.

Determination of ash content

The ash content was determined using in-house method No. STP/Chem/A02 based on AOAC 17th Edi. sub-component 923.03 [29]. About two gm of the sample were placed in the crucible that was accurately weighed (W1) and accurately weighed (W2), then ignited at 550°C in a Heracus electronic muffle furnace (Carbolite CSF 1200) for overnight, cooled in a desiccator and weighed (W3). Total ash% calculated as in Equation [2]. The experiment was done in three replicates.

$$\text{Total Ash \%} = (W3-W1)/(W2-W1)\times 100 \quad \text{.....(2)}$$

Where W1 is the weight of the empty crucible, W2 is the weight of the crucible + sample, and W3 is the weight of the crucible + sample after sufficiently drying.

Determination of mineral content

The particular mineral contents (calcium, magnesium, potassium, sodium, zinc, copper, and cadmium) and heavy elements (Arsenic, Mercury, Cadmium, antimony, lead, stanum, zinc, selenium, chromium, manganese, phosphorus, copper, and ferum) are accurately determined using the Microwave Digestion/Inductively Coupled Plasma described by Baker, [30] and Miller [31], with slight modifications. After drying with the oven at 105°C until a constant weight was obtained, they added 2 mL of 35% H_2O_2 and 5mL of 65% HNO_3 at 200°C in a closed microwave system (Cem-MARS Xpress, Australia), allowing pre-digestion of the sample for 30 minutes. Then, mineral concentrations were analyzed by ICP-optical emission spectroscopy (ICP-MS; Varian-Vista, Australia) by completing the digested sample volumes with ultra-deionized water to 20 mL. The metal concentration in this study was calculated (ICP-MS), which is calculated by Equation [3].

$$\text{Metal concentration} = (\mu g/L)/W\times V \quad \text{.....(3)}$$

Where μg/L is the ICP-MS value in parts per billion (ppb); W is the weight of the sample per gram (0.5g), and V is the volume of sample dilution (25 mL).

Determination of protein content and amino acid profile

We carefully analyzed the protein content using in-house method No. STP/Chem/A03 based on AOAC 16th sub-component 981.10 [32,33], with slight modification, weigh to the nearest 0.5 to 2g before adding 15 ml of H_2SO_4, at 420°C for 1.5h in the Kjeldahl method, in which digestion, distillation, and titration are involved. In this process, all nitrogen is converted to ammonia by digestion with a mixture of concentrated sulfuric acid (H_2SO_4) and concentrated orthophosphoric acid (H_3PO_4) containing copper sulfate and potassium sulfate (K_2SO_4) as a catalyst. The ammonia (NH_3) released after alkalinization with sodium hydroxide is steam distilled into boric acid (H_3BO_3) and titrated with hydrochloric acid (HCl). The amino acid profile is determined using water ACCQ-TAG amino acid analysis, according to Bougatef., *et al*. [34]. sample preparation (6NHCL hydrolysate). Firstly, the defatted samples were weighed (0.1-0.2g) into a hydrolysate test tube. Then, a 5ml of 6 NHCL was added before the stopper, sealed the hydrolysate test tube tightly placed the sample into the container, and closed tightly. The container was heated in the oven at 110°C for 24 hours after cooling down samples to room temperature. After that, the samples were transferred to the 100 ml volumetric flask through the filter funnel and added 400 µl of 50µmole of AABA (Internal standard) into the volumetric flask which makes up to 100ml with deionizing water. Finally, we filtered and aliquoted through a syringe filter into a screw neck vial by pipetting 01µl of sample for derivatization into a centrifuge tube. Inject the derivatization sample. The obtained amino acid composition was also used for the calculation of the chemical score, as shown in Equation [4].

$$\text{Amino acids (mg/100g)} = (\text{mg of amino acid content in the sample})/((\text{mg same amino acid in reference protein})\times 100) \quad \text{.....[4]}$$

Determination of carbohydrate

The carbohydrate (CHO's) content is typically determined using in-house method No. STP/Chem/A03 based on prominence food analysis; theory and practice, 2nd sub-component [35]. Then, the final value of 'CHO's is calculated and presented in Equation [5] below:

$$\text{vailable CHO's (g/100g)} = 100-\{[\text{Ash}]+[\text{Moisture}]+[\text{Fat}]+[\text{Protein}]+[\text{Dietary Fibre}]\} \quad \text{.....(5)}$$

Determination of a reduced sugar profile

The in-house method wisely determines the reducing sugar profile. STP/Chem/A10 is typically based on AOAC 16th Edi. 967.21[36] using the alkaline ferricyanide method. The procedure uses a single reagent composed of 0.34gm of potassium ferricyanide, 5gm of potassium cyanide, and 20gm of sodium carbonate dissolved in one liter of water. About 0.1mL of 1% sample solution was added to 4.0 mL of reagent, then heated in a boiling water bath for 10 minutes and cooled. Thermo Scientific Multiskan® GO, Model 1119200, Serial No. 1510-00000C, UV/VIS Spectrophotometer, Multiplate reader Finland, was used to measure absorbance at 420 nm. Finally, the curve of different sugar concentrations is plotted against absorbance to calculate the reducing sugar content as arabinose.

Energy determination

The potential energy was investigated by in-house method No. STP/Chem/A01 based on Pearson's chemical analysis of foods (6th Edition, page 578). The gross energy content was uniquely determined by accurate calculation from carbohydrate, crude fat, and crude protein contents gently using the 'at water's conversion factors promptly using the mathematical Equation [6] as persistently follows:

Energy (kCal/g)=(4 kCal/g×Crude protein+(9 kCal/g×Crude fat)+(4 kCal/g×Carbohydrate) .....(6)

Determination of crude fiber content

The crude fiber content of generous samples under intensive study is properly determined according to AOAC [37] using a subcomponent, in-house method, Ref. No. STP/Chem/A08, based on AOAC 16th Edi. 962.409, using an enzymatic-gravimetric method-MES-TRIS. Buffer, digestion, filtration, washing, drying, and combustion are involved. Then, proceed as for insoluble DFs determination through instruction to combine the filtrate and water washings in prepared 600 ml tall-form beakers before weighing beakers with a combined solution of filtrate and water washings, and estimate volumes. Add four volumes of preheated 95% EtOH at 60°C. Then, use a portion of 60% EtOH to rinse the filtering flask from IDF determination. Alternatively, adjust the weight of the combined solution of filtrate and water washings to 80 by adding H_2O and adding 320 mL of 60°C absolute ethanol (95%).

Statistical Analysis

All measurements were carried out in triplicate for each of the selected samples. The average and standard deviation (SD) of effective means were calculated. The observed data were analyzed using Minitab ® version 18 sophisticated software for one-way analysis of observed variance. All values were presented as an efficient means of triplicates ± SD and compared using Fisher's least significant difference. An appropriate level of $p \leq 0.05$ was intentionally used to indicate precisely significant differences among the selected samples.

Results and Discussion

Evaluation of the nutritional values of the optimum formula

Tables 1-4 present the results of the comprehensive investigations, including physical, chemical, and other crucial biological behavior of the optimum formula blended from AGs (*Acacia senegal* and *Acacia seyal*) and ADLPs. An overview of the procedure is depicted in figure 1.

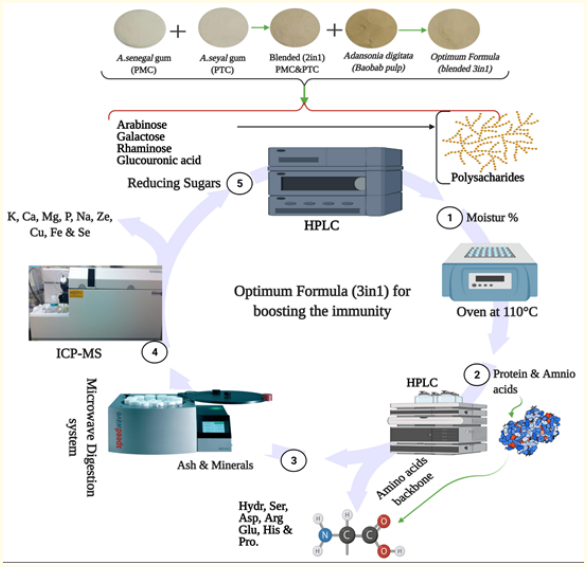

Figure 1

Physicochemical composition of the optimal formula

Proximate values

Table 1 shows the proximate values (PVs) per 100g of the optimum formula analyzed in this study. The PVs in the optimum formula of AGs were comparable to the proximate composition of the respective ADLPs blended (1in1). All three samples were typically found to be nutritionally active. The AGs samples' energy was found to have a mean value of 340.67 kcal/100g, while that of ADLPs blended (1in1) had a mean value of 350.12 kcal/100g (Table 1). These findings are within the range of values (282.03 to 454.11 kcal/100g for ADLPs blended (1in1)) reported in Eke's [38]. Analysis of variance showed significant differences ($p \leq 0.05$) between the blended (3in1) and the blended (2in1) samples. Therefore, the nutritional values of the three samples are found to be significantly ($p \leq 0.05$) different.

Moisture and Ash Content

The moisture content for blended (3in1), blended (2in1), and baobab pulp is found to be between 10.57 to 11.50%, with an outstanding value of 11% for (blended 3in1) and 11.5% for blended (2 in1) samples (Table 1). Ali and Daffalla [39] and Lelon., *et al*. [40] recorded a higher range of 14.5% to 15.2%, respectively, for AGs. However, the mean values reported here are relatively similar to the mean value of 9.16% to 10.30% reported by Aluko [39]. Statistical analysis showed a significant difference ($p \leq 0.05$) in moisture content between the formulas. Thus, moisture content falls within the international specifications range of (13%-15%) for AGs.

The average ash content was instantly found to be 3.48%, 4.0%, and 4.5% for blended (2in1), ADLPs blended (1in1), and blended (3in1) samples, respectively (Table 1). In this efficient manner, direct results obtained are precisely above the effective mean of 2.5%, reported by Ali and Daffalla [39], and higher than the values of 3.16% and 3.56% obtained by Lelon., *et al*. [40] for AGs. However, ash content levels between the formulas are found to be significantly ($p \leq 0.05$) different. In addition, the blending process significantly ($p \leq 0.05$) influenced the ash content.

Nutritional Values	PMC and PTC (Blended 2 in 1)	ADLPs (Blended 1 in 1)	Optimum formula (Blended 3 in 1)
	Mean ± S. D		
Moisture (%)	11.51 ± 0.150^{a}	10.57 ± 1.02^{b}	11.0 ± 1.350^{c}
Total Ash (%)	3.48 ± 0.0050^{c}	04.5 ± 0.3000^{a}	4.0 ± 1.2000^{b}
Fat (g/100gDW)	0.0133 ± 0.0059^{c}	0.30 ± 0.0223^{a}	0.30 ± 0.0019^{a}
Cholesterol (g/100gDW)	N.D.	0.1 ± 0.00120^{a}	0.1 ± 0.0015^{a}
Prebiotic Polysaccharide (g/100gDW)	84.00 ± 2.15^{b}	80 ± 3.20000^{c}	88.61 ± 3.1210^{a}
Protein (g/100gDW)	2.363 ± 0.0058^{c}	2.5 ± 0.11200^{b}	3.34 ± 0.12100^{a}
Carbohydrate (g/100gDW)	84.34 ± 4.577^{b}	78.40 ± 2.000^{c}	86.32 ± 3.1120^{a}
Energy (k cal/100g)	340.67 ± 3.155^{b}	322.5 ± 5.200^{c}	350.12 ± 5.210^{a}
Soluble DFs (g/100gDW)	84 ± 30.45000^{b}	48 ± 1.30000^{b}	87 ± 2.123500^{a}
Insoluble DFs (g/100gDW)	1.865 ± 0.0050^{c}	6.73 ± 1.023^{c}	12.62 ± 2.100^{a}
Crude fiber (g/100gDW)	0.0133 ± 0.0058^{c}	12.62 ± 1.300^{b}	12.82 ± 1.700^{a}
Acid Insoluble Residue (g/100gDW)	0.9100 ± 0.0120^{b}	0.90 ± 0.0110^{c}	0.95 ± 0.01560^{a}

Table 1. Chemical characterization of the optimal formula consists precisely of blended *Acacia seyal* and *Acacia senegal* gum (PMC and PTC) powder and ADLPs powder.

*Mean value ± SD in raw, followed by different superscript small letters, accurately shows the significant difference ($p \leq 0.05$) compared between rows. PMC: *Acacia Sengal* Gum (commercial), PTC: *Acacia Seyal* Gum (commercial), ADLPs: is *Adansonia Digitata* pulp powder, and N.D.: Not Detectable.

Dietary fibers (DFs)

The aqueous solutions of the final optimum formula (blended 3in1) sample are rich in DFs. The DFs were exposed correctly at 57%, while blended 2in1 and ADLPs blended (1in1) reported an exceptional value of 1.865% and 48%, respectively (Table 1). These findings are precisely within the effective range of Mariod's [41] recent results, which reported 85% dissolvable DFs of AGs. However,

the values are higher by about 6% of the values given by Gadour., *et al*. [42] for ADLPs blended (1in1). Between samples, analysis of variance revealed significant differences ($p \leq 0.05$) between the formula elements where blended 3in1 (the optimum formula) showed the highest soluble DFs and Insoluble Dietary Fibers (IDFs) content. Recent findings by Conte and Toraldo [43] show that DFs and prebiotic help manipulate microbial patterns to reduce inflammation and strengthen the HIIs response to Covid-19 infection.

Polysaccharides and Carbohydrate content

There is the visible presence of prebiotic polysaccharides (PPs) in all selected samples of the optimum formulas. The premium PPs contents of the AGs (blended 2in1) sample revealed 84%, and that of the optimum formula (blended 3in1) was found to be higher with a median value of 88.61% (Table 1). The results agree with Cao and co-workers [44] use qualitative analysis and provide evidence that polysaccharide consumption has therapeutic effects on mild and ordinary Covid-19 patients because of their lung cleansing effect through a detoxifying decoction mechanism. Chen and co-workers [45] studied the anti-activity of pulmonary fibrosis (PFs) in the lungs. They reported the underlying mechanisms of polysaccharides in preventing or treating PFs in Covid-19 patients.

The samples showed a minimum value of 78.40% and a maximum value of 86.32%, with significant ($p \leq 0.05$) variations among the three different carbohydrate content samples. ADLPs blended (1in1) samples show 78.40% of CHO's (Table 1). The fair value of AGs (blended 2in1) was precisely 84.34%, which is significant ($p \leq 0.05$) lower compared to the value of 86.32% for the optimum formula (blended 3in1) sample. This result is more extraordinary than the value of 62.58% for ADLPs blended (1in1) reported by Gurashi., *et al*. [46] related to fruit shape, types, and locations. The variation in chemical properties between the optimum formula components is mainly because of synergistic differences.

Latterly, Wei., *et al*. [47] used quantitative analysis and identified that the carbohydrate antigens (CA,125) significantly increase the levels of human epididymis in Covid-19 patients. Several researchers have also identified the effect of glycosylated SARS-CoV-2 spike (S) protein modeling and simulation for preventing and treating Covid-19 [48-51]. Furthermore, they confirmed that the S1 domain of Covid-19 spike glycoprotein interacts with the human CD26 as the immunoregulatory factor for hijacking and virulence.

Interestingly, the positive affecting of CHO's on Met-S patients has been intensively studied. For example, Kim [52] reported that the carbohydrate/glycan-recognizing proteins/molecules could contribute to virus evolution toward host tropism. Pillay., *et al*. [53] used qualitative analysis and identified that the consumption of CHO's improved the athlete's health care to (92%) when suspecting Covid-19. Finally, CHO's- CHO's interactions have correlated blood antigens' susceptibility to SARS-CoV-2 due to modulation of sialic acid-containing receptors on the host cell [54]. Thus, their findings suggest that our formula is a promising alternative superfood supplement against viral disease during an epidemic. Similar results were also reported by Steinman [55], reporting that the neurological abilities of the Covid-19 vaccination can directly help immune response due to complex carbohydrate consumption and can successfully prevent life-threatening disease. Hence, further study is needed to uncover the detail of CHO's phenomenon against Covid-19.

Protein composition

The results show that the optimum formula's protein content (blended 3in1) samples correctly were 3.34%, while AGs (blended 2in1) and ADLPs blended (1in1) samples were marginally lower with an intermediate value of 2.36 and 2.50% protein, respectively. It can be positively identified that the protein levels in the major component of the optimum formula (blended 3in1) were efficiently found to be significantly ($p \leq 0.05$) different. The average protein content in the component of the optimum formula was 2.4 and 3.34%, respectively, which is comparable to the AGs' protein values, which vary appreciably from 1.3 to 3.0%, as previously reported by many scholars [39,56-63]. These results have implications in understanding the relationship between protein and formulated products. The findings are within the range of the recent results of Aluko., *et al*. [64], who reported 3.23% to 3.53% protein for ADLPs blended (1in1) obtained from the three Tanzania locations but were higher than the values of 3.5% given by Oyeleke., *et al*. [65]. Recently, Wallace [66] observed that protein has a vital role in the calcium channel blocking (CCB) mechanism, leading to downstream suppression of nuclear factor-Kβ, interleukin-6, c-reactive protein, and other endocrine disrupters. The author observed the role of protein in regulating kidney potassium loss and its impact on promoting vitamin D functionality among over 600 enzymatic reactions, including those that contributed to the immune and in-

flammatory responses exhibited by Covid-19 patients. Thus, this effect may have important implications for protein on immunocompromised patients in the fight against the Covid-19 pandemic.

Fat and Cholesterol levels

As illustrated in table 1, the essential fats and elevated cholesterol levels of the optimum formula from blended (3in1) were found to efficiently be 0.30%, which is significantly ($p \leq 0.05$) higher compared to the mean of 0.0133% for AGs blended (2 in1) samples. Osman [67] reported a similar mean value of 0.30% for ADLPs blended (1in1). Oyeleke., *et al*. [65] reported a slightly higher mean value of 0.4 to 1.70% fat for ADLPs blended (1in1). Interestingly, in all samples, both fats and cholesterol levels have the same pattern, except AGs (blended 2in1), containing no cholesterol and fats. Thus, superfood supplements with low dietary fatty acids (DFAs) are highly recommended for obese or diabetic Covid-19 patients. However, a high intake of DFAs affected the gut microbiome by increasing intestinal permeability. For example, Gleeson., *et al*. [68] studied the relationship between obesity, Covid-19, and innate immunometabolism and affirmed that meta-flammarion, an obesity-associated factor, increased the host response to a novel viral pathogen. Thus, diets with low-fat foods are beneficial for Covid-19 patients.

Other researchers identified that DFAs positively impact Covid-19 infection outcomes in vulnerable individuals with metabolic syndrome (Met-S) diseases. Also, they provided evidence that a cytokine storm, lungs, and intestine have been targeted by Covid-19, which increased the mortality rate. Therefore, the high intake of DFAs affected the gut microbiome by increased intestinal permeability. Thus, food supplements with low dietary fats are highly recommended for obese or diabetic Covid-19 patients. Thus, they spent more time under ventilator systems than regular patients [69-72]. This illustrates one of many possible AGs applications blended with ADLPs that can boost the HIIs. For example, an aqueous solution of ADLPs exhibited anti-Met-S have reflected anti-inflammatory, weight loss, hypolipidemic, renal, hypoglycemic, hepatic and cardio-protective activities [17,73]. Hence, a biotechnological approach for formulating AGs and ADLPs is necessary.

In previous studies, an aqueous solution of ADLPs blended (1in1) has been shown to typically exhibit anti-Met-S, which naturally has positive anti-inflammatory, successful weight loss, hypolipidemic, renal, hypoglycemic, hepatic, and cardio-protective activities [17,73]. These results are positive and warrant further research into the use of blending technology for boosting-up, immunocompromised patients to fight Covid-19 disease.

Evaluation of mineral content of the optimum formula

Table 2 shows the mineral composition of AGs (blended 2in1), ADLPs blended (1in1), and blended (3in1) optimum formula. Overall, all samples' mineral content naturally varies according to the sample species, the blended ratio, and the blended process (Table 2). The macro elements such as adequate calcium (Ca), potassium (K), magnesium, phosphorus (P), and sodium (Na) were significantly ($p \leq 0.05$) higher in the optimum formula (blended 3in1) compared adequately to all other samples under the comprehensive study.

Calcium content

The calcium concentration of blended (2in1), ADLPs blended (1in1), and the optimum formula (blended 3in1) samples, respectively, have a mean value of 0.9343.6, 68.20, and 68.54 g/100gDW. These consistent results are moderately deeper than the nutritional value of 0.70g/100g DW calcium for AGs reported by Yebeyen., *et al*. [63] and 0.375 to 0.43g/100g ADLPs blended (1in1) reported by Muthai., *et al*. [74] and Stadlmayr., *et al*. [75], respectively.

Sufficient evidence from several prospective cohort studies of Abdel Massih., *et al*. [76] indicated that calcium served as an ion channel inhibitor for preventing cellular transfection early in Covid-19 patients. This was confirmed by Jayaseelan [76], and Sun., *et al*. [77] found that CCBs were significantly associated with Covid-19 patient treatment. Thus, serum calcium has been associated with the clinical severity and prognosis of patients with Covid-19.

Potassium content

The potassium (K) content of the optimum formula (blended 3in1) samples was miraculously found to be 70.56 g/100gDW, which is significantly ($p \leq 0.05$) higher compared to the mean

Metals	PMC and PTC (Blended 2in1)	ADLPs (Blended 1in1)	Optimum formula(Blended 3in1)
	Mean ± S. D		
Calcium	(g/100gDW) 0.9343.0 ± 0.0200^{c}	(g/100gDW) 68.20 ± 2.50^{c}	(g/100gDW) 68.54 ± 3.12^{b}
Potassium	0.2359.02 ± 0.050^{c}	70.22 ± 4.30^{b}	70.56 ± 2.35^{a}
Magnesium	0.1654.01 ± 0.0300^{c}	16.52 ± 4.80^{b}	16.60 ± 4.80^{a}
Phosphorus	0.0301 ± 0.00100^{c}	11.50 ± 2.500^{a}	11.50.00 ± 3.70^{a}
Sodium	0.0408 ± 0.00100^{b}	31.90 ± 1.200^{a}	31.40 ± 4.80^{a}
Zinc	0.000122^{c}	1.8 ± 0.11000^{b}	1.9.00 ± 0.14^{a}
Copper	0.000116^{c}	1.6 ± 0.10130^{b}	19.19 ± 2.100^{a}
Iron	0.000122^{c}	9.3 ± 1.14200^{b}	15.12 ± 1.812^{a}
Selenium	0.000004^{c}	0.036 ± 0.005^{a}	0.037 ± 0.005^{a}
Mercury	0.0000028^{c}	0.05 ± 0.0020^{a}	0.050 ± 0.005^{a}
Arsenic	0.0000020^{c}	0.015 ± 0.002^{a}	0.011 ± 0.003^{a}
Lead	0.000001^{c}	0.02 ± 0.0120^{a}	0.02 ± 0.012^{a}
Cadmium	N.D.	0.0133 ± 0.003^{a}	0.0113 ± 0.002^{ab}
Antimony	N.D.	0.0123 ± 0.001^{a}	0.0123 ± 0.004^{a}
Tin	N.D.	0.040 ± 0.0020^{a}	0.040 ± 0.001^{a}

Table 2. Mineral's profile of the optimal formula consists precisely of *Acacia seyal* and *Acacia senegal* gum (PMC&PTC) powder and ADLPs powder.

*Mean value ± SD in raw, followed by different superscript small letters, shows the significant difference ($p \leq 0.05$) compared between rows. PMC: *Acacia sengal* gum (commercial), PTC: *Acacia seyal* gum (commercial), ADLPs: is *Adansonia Digitata L* pulp powder, and N.D.: Not detected.

value of 70.22g/100gDW for ADLPs blended (1in1) samples (without gum). However, the K concentration of only AGs (blended 2in1) was significantly lower than the average value of 0.2359 g/100gDW compared to both blended samples. Stadlmayr., *et al*. [75], Abdullahi., *et al*. [78], and Eke., *et al*. [38] reported a significantly lower mean value of 1.006g/100gDW, 0.240g/100 DW, and 0.125 g/100gDW of potassium, respectively, for pure ADLPs blended (1in1). The difference in potassium content and other metals investigated in this study can be attributed to factors, including the locations, quantification methods, and blending process.

Consequently, this study convincingly shows that the blending technology of organic bioactive compounds positively affects the potassium content of the optimum formula against Covid-19. Potassium (K)'s potential applications in potential Covid-19 patients' effective treatment have been widely described by Chen., *et al*. [79]. They reported (using a multinational case-control study) that the high prevalence of hypokalemia (low level of K+) among Covid-19 patients is correlated with renal potassium loss due to degradation of Angiotensin-Converting Enzyme 2, which can cause severe acute respiratory syndrome Covid-19. Hence, K+ is hugely recommended to be consumed by patients with Covid-19. A study of therapeutic agents for immune transfer factors by Ferreira., *et al*. [80] found that potassium, zinc, selenium, ascorbic acid, vitamin-E, and ferulic acid are associated with the prevention and improvement of Covid-19 symptoms.

Magnesium content

As shown in table 2, the optimum formula (blended 3in1) is reliably found to contain precisely 16.60g/100gDW magnesium, which is slightly higher than 16.52g/100gDW Mg found in the ADLPs blended (1in1) (without gum) samples. On the other hand, the samples prepared from AGs (blended 2in1) scientifically showed the lowest average value by 0.1654g/100gDW compared

to the blended samples. This remarkable result remains double the excellent value of 0.201g/100g DW reported by Yebeyen., *et al*. [63] for AGs, but lower in comparison with the value of 0.23g/100g and 0.019g/100g DW reported by both Muthai., *et al*. [74] and Eke., *et al*. [38] for ADLPs blended (1in1) respectively. In addition, Iotti., *et al*. [81] confirmed some pathogenesis of Covid-19 patients due to magnesium deficiency, such as a drop in T-cells. This argument is consistent with Alkhatib's [82] findings, suggesting those trace elements, including magnesium, zinc, iron, selenium, and copper derivatives, from Functional Foods, translated into protection against respiratory viral infections and Covid-19.

Phosphorus content

The phosphorus (P) content of both the optimum formula (blended 3in1), and ADLPs blended (1in1), comparable samples were found to receive the same average of 11.50g/100gDW graciously. In favorable comparison, AGs (blended 2in1) samples showed merely 0.0301g/100gDW potassium. Analysis of variance revealed significant differences ($p \leq 0.05$) between the blended and non-blended samples. This research represents the first step toward a more profound understanding of the phosphorus level in blended and non-blended samples. Kinuthia., *et al*. [83] recorded significantly lower mean values of 0.11g/100gDW for ADLPs blended (1in1).

However, the mean values reported here were significantly higher than the mean value of 0.6 g/100gDW for AGs indicated by Yebeyen., *et al*. [63]. The outcome of various experiments during element detection concludes that the titration methods had some limitations based on comparing our results obtained in ICP-MS with those detected in advanced instrumental techniques. Hence, one exciting area of future research is to examine ICP-MS methods as a standard benchmark in blended technology due to their accuracy. The recent findings by Bigley., *et al*. [84] Phosphorus (P) can be used as a stereoselective variant of the phosphodiesterase by developing a chemo-enzymatic strategy from *Pseudomonas diminuta* utilizing facial enabled isolation of the pure-diastereomer or remdesivir drug. Thus, there is still a great deal of work to be done in this area of biological application of phosphorus and its mechanism on vaccines and boosting the immune systems.

Sodium content

Both sample formulas (blended 3in1) and ADLPs blended (1in1) samples were found to contain similar values of 31.4 and 31.90g/100gDW sodium (Na), with an average value of 31.65g/100gDW, while AGs (blended 2in1) samples showed the minimum average value, 0.0408g/100g DW of sodium. Statistical analysis demonstrated a significant difference ($p \leq 0.05$) in sodium content between the blended and non-blended samples. These findings are not within the range of the previous results of Kinuthia., *et al*. [83], who reported 0.1g/100g DW sodium for ADLPs blended (1in1), and Yebeyen., *et al*. [63], who reported 0.01g/100g DW for AGs. Further study is still required for sodium profiling using ICP-MS rather than titration methods. Meanwhile, Post., *et al*. [85] demonstrate the link between sodium intake and mortality rate in Chinese. Because of their high sodium intake confirmed that the MR due to Covid-19 infections among Chinese was very low compared to other countries worldwide.

Trace elements

Our most intriguing finding is precisely that the essential trace elements, namely copper, iron (Fe), zinc, and selenium (Se), were assuredly found to be 19.19, 15.12, 1.9, and 0.0037g/100g DW for the optimum formula (blended 3in1) sample compared to AGs blended (2in1) which were free from all these TEs (Table 2). Thus, the appropriate TEs levels in the two blended samples were significantly ($p \leq 0.05$) different. These consistent findings adequately support the fundamental concept of blending between the AGs and ADLPs in presidential terms of 3in1 blending to properly support the remarkable generation of an optimum formula for developing the HIIs.

These accurate results are undoubtedly in good agreement with the fundamental value of 0.001g/100gDW reported by Yebeyen., *et al*. [63], excluding non-detectable traces of Zn, Cu, Pb, Cd, Co, Ni, Mn, and Cr. An important aspect to remember when designing the optimum formula and running the experiments is the concentration of heavy metals formulated according to the FDA and WHO specifications, so that the final products are healthy for human consumption. The TEs in our optimum formula are compatible with those obtained from the FDA's standard requirement, as reported earlier by Talebi., *et al*. [86]. The specific values used for each metal are summarized in table 2. Kieliszek and Lipinski [87] describe how TEs, such as selenium, improve immune function against poliovirus in adults with low selenium levels. In a similar context, Jayawardena., *et al*. [88] and Razzaque [89] reported the beneficial effects of oral zinc supplement (a trace element) on the immune response of older adults, suggesting the critical role of TEs for balanced immune response.

Evaluation of protein content and AAs in the optimum formula

Table 3 shows AAs in AGs (blended 2in1), ADLPs (1in1), and the optimum formula blended (3in1). Overall, the AAs content in inter prepared samples varies tremendously according to the blended process and sample species. The total Essential Amino Acids (EAAs) content of the optimum formula (blended 3in1) was found to be 96.27g/100gDW, which is significantly ($p \leq 0.5$) higher than the earned averages for ADLPs blended (1in1) (31.41/100gDW) and AGs (2in1) (42.11g/100gDW) samples respectively. The determined values for None Essential Amino Acids (NEAAs) are 32.16g/100gDW, 51.63g/100gDW, and 85.07g/100gDW for AGs (blended 2in1), ADLPs (1in1), and optimum formula (blended 3in1).

Hydroxyproline and serine content

The serine levels (18.45g/100gDW) in the optimum formula were fortunately found to be significantly ($p \leq 0.05$) higher compared to all the NEAAs found in the extensive study. Ibrahim., *et al*. [90] recorded a low value of 3.37g/100gDW of serine for ADLPs blended (1in1) compared to the 18.45g/100gDW of serine for our optimum formula due to blending. The hydroxyproline content of the optimum formula (blended 3in1) samples was 30.17g/100gDW, while that of AGs blended (2in1) was relatively lower at 22.07g/100g DW. Hydroxyproline is negligible in many plants' food sources, including ADLPs blended (1in1), as Wu [91] highlighted.

Amino acid	PMC and PTC (Blended 2in 1)	ADLPs (Blended 1in1)	Optimum formula (Blended3in1)
	Mean ± S. D		
	(g/100gDW)	(g/100gDW)	(g/100gDW)
Hydroxyproline	22.07 ± 0.513^{b}	N.D.	30.17 ± 0.122^{a}
Histidine	2.30 ± 0.608^{hij}	2.23 ± 0.058^{uvw}	13.50 ± 0.71^{gh}
Isoleucine	1.57 ± 0.321^{wxy}	2.23 ± 0.057^{uvw}	3.77 ± 0.150^{st}
Leucine	7.17 ± 0.577^{jkl}	4.37 ± 0.116^{qrst}	12.4 ± 0.460^{gh}
Lysine	2.60 ± 0.346^{t}	1.73 ± 0.058^{vwx}	3.80 ± 0.100^{st}
Cysteine	N.D.	0.90 ± 0.100^{yzaa}	0.95 ± 0.012^{yzaa}
Methionine	0.11 ± 0.010^{za}	0.197 ± 0.006^{za}	0.32 ± 0.020^{za}
Tyrosine	1.80 ± 0.100^{vwxy}	7.70 ± 0.173^{klmno}	$9.50.43 \pm 0.40^{f}$
Phenylalanine	1.83 ± 0.056^{vwxy}	4.53 ± 0.231^{pqrst}	8.27 ± 0.21^{klmn}
Threonine	$1.80 \pm 0.100l^{vwxy}$	2.70 ± 0.17^{th}	8.7 ± 0.52^{klm}
Valine	2.93 ± 0.058^{pqrst}	4.83 ± 0.057^{pqrst}	9.47 ± 0.35^{ijk}
Total EAA	44.18	31.41	96.27
Arginine	1.33 ± 0.058^{xyz}	7.70 ± 0.17^{klmno}	14.44 ± 0.15^{ef}
Glutamine	5.43 ± 0.404^{opqrst}	6.60 ± 0.17^{mnopq}	11.31 ± 0.29^{hij}
Asparagine	9.40 ± 0.265^{jk}	6.43 ± 0.058^{mnopqr}	14.83 ± 0.14^{ef}
Proline	11.23 ± 0.58^{hij}	2.370 ± 0.38^{t}	11.87 ± 0.81^{hi}
Serine	16.57 ± 0.57^{d}	3.37 ± 0.29^{th}	18.45 ± 0.44^{ec}
Alanine	4.10 ± 0.17^{rst}	3.47 ± 0.29^{th}	7.67 ± 0.19^{klmno}
Glycine	3.57 ± 0.115^{th}	2.667 ± 0.41^{t}	6.50 ± 0.25^{nopqr}
Total NEAA	51.63	32.16	80.87

Table 3: Amino acid composition of the optimal formula consists precisely of *Acacia seyal* and *Acacia senegal* gum (PMC and PTC) powder and ADLPs powder.

*Mean value **±** SD in raw, followed by different superscript small letters, shows the significance ($p \leq 0.05$) compared between rows. PMC: *Acacia sengal* gum (commercial), PTC: *Acacia seyal* gum (commercial), ADLPs: *Adansonia Digitata* pulp powder; EAA: Essential Amino Acids and NEAA: None essential amino acids.

However, as León de Pinto., *et al*. [92] reported, about 18% of the AGs component is characteristically rich in hydroxyproline, serine, and threonine. This fact supports the importance of blending with AGs to obtain the rich optimum formula blended (3in1). Thus, hydroxyproline and serine have broad potential applications as antiviral agents. Interestingly, Wu [91] reported a positive effect of hydroxyproline in promoting the immunological defense of individuals against not only coronavirus but also several other infectious diseases caused by fungi, bacteria, and parasites, due to its boosting mechanism of the IIS by enhancing the metabolism and functions of the immune system cells.

Asparagine and arginine content

In this extensive study, both asparagine and arginine content classified under the critical term "NEAA" were 14.44g/100gDW for the optimum formula (blended 3in1). The optimal NEAAs levels among blended and non-blended samples are significantly ($p \leq 0.05$) different. These excellent results are positively within the range of 1.30 and 9.40g/100gDW of arginine and asparagine, respectively, reported by Salem., *et al*. [93] for AGs; and higher than the values of 6.30 and 9.21g/100gDW of arginine and asparagine, respectively, obtained by Ibrahim., *et al*. [90] for ADLPs blended (1in1). Gambardella., *et al*. [94] reported that arginine's role is crucial for boosting the 'individual's IIS by controlling a list of Met-S such as hypertension, aging, peripheral artery, diabetes mellitus, and ischemic heart disease. Similar results were reported by Arisan., *et al*. [95], confirmed that Peptidyl Arginine Deiminases have essential roles in-host responses to SARS-CoV-2 and therapeutic targets Covid-19 due to the post-translational deamination mechanisms. Thus, a formula with high arginine may be essential for treating and controlling the Covid-19 pandemic.

Glutamine, histidine, and proline

Glutamine for the blended (3in1), histidine, and proline for AGs were the same average of 11.28g/100gDW, respectively. No significant differences ($p \leq 0.05$) between the glutamine, histidine, and proline were observed among the specific samples of the optimum formula (blended 3in1) and AGs blended (2in1). However, Salem., *et al*. [93] reported a mean value of 5.20, 10.90, and 11.60g/100gDW of glutamine, proline, and histidine, respectively, for AGs. Ibrahim., *et al*. [90] reported similar results (2.14, 7.94, and 12.23g/100gDW) of histidine, proline, and glutamic acid, respectively, for ADLPs blended (1in1), which may explain the similarity of these AAs between the two different types of formula. Chen., *et al*. [96] confirmed that several AAs, including proline arginine, glycine, glutamine, taurine, and tryptophan, can react to Reactive Oxygen Species; therefore, can regulate immune responses against Covid-19 by enhancing epithelial barriers. For instance, Mirza., *et al*. [97] suggest that the histidine and asparagine inhabited papain-like proteases (PLpro) by the innate immune response during SARS-CoV-2 infection are, consequently, considered crucial antiviral targets for Covid-19. M., *et al*. [98] identified that serine-441, histidine-296, and aspartic acid-345 are considered active binding sites of Transmembrane Serine Protease 2 (TMPRSS2) phytochemicals, which can inhibit Covid-19. According to Cengiz., *et al*. [97], feeding supplemented glutamine to Covid-19 patients during the early period could result in fewer ICU visits and a shorter hospital stay. Furthermore, they confirmed that glutamine boosts the IIS by inhibiting inflammatory responses. Thus, this study contributes valuable contributions as the blended formula can help uncompromized people during the Covid-19 pandemic.

Alanine, phenylalanine, and threonine

After rigorous investigation, it was correctly observed that the exceptional value of alanine (7.67g/100gDW), phenylalanine (8.27g/100gDW), and threonine (8.70g/100gDW) for the optimum formula (blended 3in1), in addition to arginine (7.70g/100gDW) for ADLPs blended (1in1), were insignificant ($p \leq 0.05$) between essential and non-essential AAs. Consistent results indicated that phenylalanine, alanine, and threonine mean values for AGs were 3.80, 4.00, and 6.80 g/100gDW, respectively. Salem., *et al*. [93] compared the relatively higher values of alanine (5.06g/100gDW), phenylalanine (5.65g/100gDW), and threonine (8.78g/100gDW). Remarkably, Aktas., *et al*. [99] reported the role of several AAs, including phenylalanine, glycine, tyrosine, and asparagine, as headliner AAs in the interactions between arbidol as an antivirus drug and the binding domains of spike glycoproteins in the SARS-CoV2. Huang., *et al*. [100] reported observations on aminotransferase levels of both alanine and asparagine. They summarized that the lowest albumin level (hypoalbuminemia) is always associated with severe Covid-19 cases; therefore, albumin infusion's therapeutic value during Covid-19 is urgently explored at the earliest

stage of infection. Wang., *et al*. [101] reported threonine's effect on suppressing cytokine storm, inflammation, alleviating pulmonary edema, and decreasing fever among Covid-19 patients.

Based on the data analysis, it is possible to generate some hypotheses about the synergistic effect of alanine on boosting the innate immune system among metabolic syndrome (MeT. S) patients during the Covid-19 pandemic. Alanine has a positive impact on diagnoses of the Covid-19 patient associated with Met-S; for instance, Kang., *et al*. [102] confirmed that obese people are more vulnerable to be affected by Covid-19 they considered a potential risk factor of the prognosis. Moreover, Li., *et al*. [103] suggested that cardiovascular disease patients were at a most decisive risk factor for both massive and bad prognosis and during Covid-19. Thus, comprehensive medical care must be directed toward patients with CVD during Covid-19. Riebeling., *et al*. [104] approved that both threonine and serine serve as receptors interaction as Protein Kinase 1 (RIPK1), which is primary critical mediation of inflammation cell death regulation. They identified that RIPK1 inhibition would facilitate RIPK1-dependent organ damage in Met-S patients associated with; kidney failure, stroke, systemic inflammatory response syndrome, myocardial infarction, and systemic inflammatory response syndrome.

Asparagine, cysteine, serine, leucine, threonine, and glutamine can be adequately considered as the direct binding of antiviral drugs against Covid-19; they efficiently serve as the main protease polymerase inhibitors [105]. Hence, these AAs groups have an essential role in the Covid-19 pandemic, and therefore, its re-formulation in the blend of AGs and ADLPs is exceptionally crucial.

Valine and leucine

Valine and leucine levels of AGs and ADLPs as non-blended samples were similar, typically getting the exact value of 4.67g/100gDW, while the optimum formula (3in1) samples showed double the modest values of 9.47g/100gDW for valine and 12.4g/100gDW for leucine. The average values for valine and leucine from AGs blended 2in1 (3.80, 4.90, and 9.50g/100gWD) respectively, as reported by Salem., *et al*. [93], are considered significant compared to the values of (5.31, 5.49, and 5.63g/100gDW) of valine, leucine, and phenylalanine, respectively, confirmed by Ibrahim., *et al*. [90]. For ADLPs blended (1in1) samples. These values are relatively lower than the result of the optimum formula (3in1) samples.

The human Amino Peptidase N-gene can be prevented only during the conversion of alanine to valine; therefore, a broad spectrum of exclusive APN domains critically occurs for coronavirus binding [106]. These merits result in valine having broad potential applications for boosting the IIS. Moreover, Shi., *et al*. [107] confirmed that valine could also serve as insoluble intercellular aggregates against Covid-19 development.

Glycine

The glycine and phenylalanine content of AGs and prepared samples were similar, meticulously maintaining the same average of 3.65g/100gDW, which was significantly ($p \leq 0.05$) different from the mean values of 3.78g/100gDW for the optimum formula (blended 3in1). There are clear benefits to glycine as a superfood supplement, particularly during the Covid-19 period. Evans., *et al*. [108] reported the synergistic effect of glycine during food processing. They approved no destruction or even a change during the integration between glycine, threonine, asparagine, and glutamine due to reacting between free AAs and free carboxyl groups of lysine arginine and with histidine imidazolyl group to create resistant force enzymatic cleavage using a peptide-type linkage. Thus, these phenomena can be achieved by only blended technology.

Evaluation of reducing sugar in the optimum formula

Reducing the sugar content of the optimum formula (blended 3in1) revealed the most significant concentration of arabinose precisely. As presented in (Table 4), the arabinose content of ADLPs blended (1in1) and the optimal formula (blended 3in1) samples were reasonably found to be 48.23g/100gDW and 49.97g/100gDW, respectively. In remarkable contrast, the AGs (blended 2in1) samples demonstrated significantly more limited outstanding values of 2.27g/100gDW of arabinose than the optimum formula (blended 3in1). Analysis of variance proved significant differences ($p \leq 0.05$) among all samples. These favorable results agree with Lopez., *et al*. [109], who reported a mean value of 30.3 and 47.60 g/100gDW, respectively, for *Acacia senegal* and *Acacia seyal* gum. Similarly, Menzies., *et al*. [110] reported an average of 24 to 29g/100gDW of arabinose for *Acacia senegal* gum and 41 to 45g/100gDW arabinose for *Acacia seyal* gum, which may explain the similarity of the reducing sugar content of the two other types of gum. Similar re-

sults are also achieved by Alba., *et al*. [111], who reported a mean value of 2.1g/100gDW of arabinose for ADLPs blended (1in1). Thus, the blending of AGs with ADLPs has helped scale up arabinose concentration. In this process, a great deal of understanding has been gained about arabinose as an ingredient against covid-19 as described by Schwarz., *et al*. [112], who confirmed that the arabinose residue as carried by juglanin at 2.3μM could serve as potent inhibitors of the three channels against Covid-19.

Galactose content

The galactose content of AGs blended (2in1) and the optimum formula (blended 3in1) samples were 36.96 and 37.17g/100gDW, respectively. These unique consistency findings are within the effective range of the published results of Lopez., *et al*. [109], who reported 35.8 to 36.9g/100gDW galactose for *Acacia senegal* and *Acacia seyal* gum but are higher than the values of 36g/100gDW and 42g/100gDW galactose, respectively, reported by Menzies., *et al*. [110]. Alba., *et al*. [111] reported the same mean value of 0.90 g/100gDW for galactose regarding ADLPs blended (1in1). Within each sample, the analysis of variance showed significant differences ($p \leq 0.05$) between the samples. Relevant to galactose, the three samples proved to be slightly different. Galactose and rhamnose content of ADLPs blended (1in1) samples showed the same range of 0.94 to 0.95g/100gDW, with an average value of 0.95g/100gDW. The levels of galactose and rhamnoses in the ADLPs blended (1in1) were slightly ($p \leq 0.05$) different.

Reducing Sugar	PMC and PTC (Blended 2in1)	ADLPs (Blended 1in1)	Optimum formula (Blended 3in1)
	Mean ± S.D.		
Arabinose	(g/100gDW) 48.23 ± 0.58^{b}	(g/100gDW) 2.27 ± 0.28^{k}	(g/100gDW) 49.97 ± 0.58^{a}
Galactose	36.96 ± 1.3^{c}	0.95 ± 0.12^{l}	37.16 ± 0.59^{c}
Rhaminose	16.39 ± 0.59i	0.95 ± 0.15^{l}	17.16 ± 0.60^{h}
Glucouronic acid	19.19 ± 1.30^{g}	27.27 ± 0.56^{e}	32.237 ± 1.50^{d}
Fructose	0.093 ± 0.002^{m}	3.57 ± 0.23^{j}	3.63 ± 0.23j
Glucose	N.D (< 0.001)	3.70 ± 0.17^{j}	3.76 ± 0.11^{j}
Sucrose	N.D (< 0.001)	22.16 ± 0.59^{f}	22.16 ± 0.60^{f}
Maltose	N.D (< 0.001)	N.D (< 0.001)	N.D (< 0.001)
Lactose	N.D (< 0.001)	N.D (< 0.001)	N.D (< 0.001)

Table 4: Reducing sugars content of the optimal formula consists precisely of *Acacia seyal* and *Acacia senegal* gum (PMC and PTC) powder and ADLPs powder as g/100gDW.

*Mean value ± SD in raw, followed by different superscript small letters, shows the significant difference ($p \leq 0.05$) compared between rows. PMC: *Acacia sengal* gum (commercial), PTC: *Acacia seyal* gum (commercial), ADLPs: *Adansonia Digitata* Pulp Powder; EAA: Essential Amino Acids and NEAA: None Essential Amino Acids.

Glucuronic acid

The presence of glucuronic acid (GUA) in all selected samples of the optimum formula indicated that all samples produced acidic sugar (glucuronic acid) acid content of AGS (blended 2in1) samples was ordinarily found to be precisely 19.19 g/100gDW, and that of ADLPs blended (1in1) prepared samples was found abundantly to be 27.27g/100gDW. In fundamental contrast, the likely result is relatively more admirable than the median value of 32.24g/100gDW of glucuronic acid for blended (3in1) (Table 4). Analysis of variance indicated significant differences ($p \leq 0.05$) among all identified samples. Table 4 shows that the blending process significantly affected the glucuronic acid content. Visible results accurately showed here were comparable to the nutritional values between

6.7g/100gDW to 17.40g/100gDW reported for *Acacia seyal* and *Acacia senegal* gum by Lopez., *et al*. [109]. It is also similar to the mean value of 30.2g/100gDW glucuronic acid for ADLPs blended (1in1) reported by Alba., *et al*. [111]. Some critical applications of glycoproteins against Covid-19 can be seen in the role of a codon in the genetic code [113]. The only other work considering the importance of GUA as an antiviral. For example, Jin., *et al*. [114] reported that glucuronic acid as glycoproteins combined with human Angiotensin-Converting Enzyme 2 serve as critical targets for preventing and treating Covid-19 patients.

Sucrose content

The sucrose content of the optimum formula aqueous solution was highly acidic (sucrose). Table 4 shows that the sucrose content of ADLPs blended (1in1) and the optimum formula (3in1) samples typically receive the same mean value, 22.17g/100gDW. However, slight differences in the sucrose content were justly observed among both selected samples. The mean sucrose concentration for ADLPs blended (1in1) and the optimum formula (3in1) samples (22.17g/100gDW) were significantly ($p \leq 0.05$) higher compared to that for AGs (blended 2in1) samples (less than 0.001). Concerning the reducing sugars, independent samples from AGs (blended 2in1) revealed a precise minimum value of 0.95 g/100gDW of rhamnose, and maximum values of 16.39 and 17.16g/100gDW for both ADLPs blended (1in1) and the optimum formula blended (3in1), respectively, with significant (p 0.05) variations among the three diverse blended samples from the same source.

Fructose and glucose content: As illustrated in Table 4, the fructose and glucose content of the ADLPs blended (1in1) and the optimum formula (blended 3in1) samples typically vary from 3.57 to 3.77g/100gDW with an average value of 3.67g/100gDW. Comprehensive analysis of variance instantly revealed no significant differences ($p \leq 0.05$) between the blended and non-ADLPs samples. Likely results indicate precisely that the fructose and glucose content of selected AGs samples approximately approached zero (0.00 to 0,093 g/100gDW), while that of the optimum formula (blended 3in1) sample approached 3.63g/100gDW. Both fructose and glucose levels in the three selected samples were significantly ($p \leq 0.05$) different. Finally, as an ultimate conclusion obtained in this comparative study, maltose and lactose were undetected.

Conclusion

This comprehensive study, conducted for the first specific time, properly presents an extensive investigation of the AGs blending with ADLPs as a prospective solution for the possible fight against the Covid-19 pandemic. Overall, several vital molecular structures/essential micronutrients, such as carbohydrate, functional protein, necessary minerals (potassium, calcium, magnesium, phosphorus, and sodium), AAs (hydroxyproline, arginine), sugars, prebiotic, and TEs (zinc, iron, copper, and selenium), are undoubtedly found in the optimum blended formula which has been scientifically demonstrated to traditionally have critical roles in generously supporting the human innate immune system (HIIs) and reducing the risk of asymptomatic infections. Besides, all the essential nutrients traditionally have leading roles inadequately supporting antiviral defenses and antivirals, especially zinc and selenium, which seem extremely important for this active role. Therefore, it would seem prudent for people to eagerly consume adequate amounts of vital nutrients to positively enhance their IIS to help them deal with infectious pathogens if they become infected. Furthermore, this comprehensive study's key findings convincingly portray a significant economic benefit since consuming a healthful diet of diverse and varied plant-based and animal-based foods naturally aligning with the current healthy eating protocol would best support the human IIS. Based on these results, it can be concluded that the AGs blended with ADLPs constitute a natural source of potential superfood support for the human IIS that could be beneficial in imbacting the Covid-19 pandemic and the prevention of many other viral diseases.

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Conflict of Interest

The authors declare that there is no conflict of interest.

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