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ORIGINAL RESEARCH ARTICLE

Comparative Evaluation of Garlic (*Allium sativum*) Bulb Syrup and Elixir as a Food Supplement: Nutritional Content, Quality and Stability Assessment

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***Abstract*— Garlic has a wide spectrum of nutritional properties, including carbohydrate, fat, protein, minerals, and vitamins. Thus, it has been utilized worldwide not only as a food supplement but also therapeutically. The present study aimed to determine the potential of garlic (*Allium sativum*) bulbs for use as a food supplement in two different dosage forms: syrup and elixir. Both samples were examined regarding nutritional composition, physical characteristics, and temperature stability through qualitative and quantitative analysis, quality control tests, and sensory evaluation. For the physical characteristics, most were in accordance with the official standards defined in the US Pharmacopoeia (USP). Specifically, the elixir's pH (6.79), viscosity (0.5 poise), alcohol content (23.28%), and specific gravity (1.16) exceeded the official standards of 6-7, 0.5–0.6poise, and 4–40%. Both the syrup's pH (6.68) and the viscosity (0.25 poise) were satisfactory based on the standards of 6-7 and 0.245poise, respectively. However, its specific gravity (1.26) fell short of the standard (1.313). Furthermore, there was no apparent difference between the two formulations when tested at different temperatures, with mean values of both 5.0 (highly acceptable) when stored in an oven and refrigerated and 4.4 (acceptable) at room temperature. Each 5mL of syrup formulation (0.5g garlic extract) had higher carbohydrate (3.165g), calorific values (0.01265kcal), potassium (0.585mg), and ash content (0.00455g) than the elixir with 2.96g, 0.01185kcal, 0.4735mg, and 0.0035g, respectively. However, the elixir's fat and moisture content (0.000955g and 2.03g) were higher than the syrup (0.00357g and 1.83g), while their protein and vitamin C content were comparable (both less than 0.004375g and 0.025mg). Therefore, there is no significant difference in the nutrient contents of garlic bulb (*A. sativum*) supplements elixir and syrup, having means of 0.689 and 0.703, respectively. Hence, whether as a syrup or an elixir, garlic bulb has the potential to be formulated as a food supplement.**

Keywords*— *Garlic bulb, syrup, elixir, nutrient content, stability, quality

I. INTRODUCTION

Garlic (*Allium. sativum*) has been used as a herbal medicine from ancient times up to the present day, owing to its diverse nutrients and functional elements. However, despite its great nutritional and medicinal properties, one of the primary reasons why raw garlic is not widely consumed in many countries is due to its unpleasant odor and taste (Kim et al., 2019). Hence, one effective way to increase its palatability is to formulate it into a dosage form. Moreover, through this, the solubility, bioavailability, pharmacological activity, and stability of the herb could be enhanced, toxicity could be reduced, and consumer compliance could be increased (Ashfaq et al., 2021).

Garlic's (*A. sativum*) nutritional value includes macronutrients such as carbohydrates, fat, and protein, which are essential for providing energy, as well as dietary fiber, which aids digestion. Furthermore, it contains minerals such as calcium, phosphorous, magnesium, and manganese, which contribute to the strengthening and overall health of bones; iron, which helps build hemoglobin in the blood; potassium, which maintains fluid balance in the body; sodium, which increases metabolism; and zinc, which aids in the proper functioning of our senses. Aside from that, it contains a variety of vitamins, including Thiamine (B1), Riboflavin (B2), Pantothenic acid (B5), and Pyridoxine (B6), which aid in cellular energy production, Niacin (B3), which promotes skin health, Folate (B9), which aids in normal blood formation, and vitamin C, which acts as an antioxidant.

Extracts and isolated compounds were found to possess anticarcinogenic, antioxidant, anti-diabetic, renoprotective, anti-atherosclerotic, antibacterial, antifungal, antiprotozoal, and antihypertensive actions in an analysis focused on the chemical composition and pharmacological properties of *A.*

sativum. Garlic is also recognized for its immunomodulatory and anti-inflammatory properties (El-Saber Batiha et al., 2020). To support, other studies have also found that garlic supplementation had a significant effect on serum inflammatory, oxidative stress, blood pressure, and lipid parameters (Mirzavandi et al., 2020; Askari et al., 2021; Zadhoush et al., 2021).

Food supplements contain concentrated deposits of nutrients, including vitamins and minerals, or various compounds with nutritional or physiological properties that are supplied in different dosage forms, such as pills, tablets, capsules, or liquids in defined quantities. Food supplements may contain a variety of nutrients and other components, including but not limited to vitamins, minerals, amino acids, essential fatty acids, fibre, and other plant and herbal extracts. This is important for human health because it may solve nutritional imbalances, sustain adequate quantities of important nutrients, or support various bodily functions. They are not pharmaceuticals and so cannot have pharmacological, immunological, or metabolic effects. As a result, their use is not meant to cure or prevent human illnesses or to alter physiological processes (European Food Safety Authority, 2022).

It is evident that garlic has been used as a food product across the globe. Today it became an inseparable part of our diet (Nair et al., 2021). Scholars around the world have proven garlic for its medicinal use in the treatment & prevention of certain diseases. It possesses both curative and preventative properties; the new focus is on its use in the prevention of heart attack and cancer. By studying these properties of *A. sativum*, it can be categorized as a nutraceutical (Tijani et al., 2019). Garlic has been used for centuries to treat a variety of ailments, including bronchitis, respiratory issues, digestive issues, flatulence, leprosy, menstrual cramps, high blood pressure, diabetes, as well as externally for warts, corns, arthritis, muscle pain, neuralgia, and sciatica (Sachan et al., 2018). Garlic is regarded as a warming, diuretic, expectorant, carminative, anti-coagulant, anthelmintic, and immune-boosting substance in Ayurvedic medicine. Researchers are investigating the use of garlic in the prevention and treatment of many ailments. Garlic is used homeopathically to treat digestive issues, rheumatism, and inflammation of the upper respiratory system. The allyl in garlic, which is also present in several members of the onion family, is regarded as a particularly valuable medicinal component. Diallyl dysulfur and alliin are very flammable and easily melt into liquids and gases. They are carried by the blood and infused into all human tissues and organs, acting on the entire body as a result (Kovarovi et al., 2019). Vitamin B-1, vitamin C, vitamin A, flavonoids, ascorbic acid, phosphorus, potassium, sulphur, selenium, calcium, magnesium, germanium, sodium, iron, manganese, and trace amounts of iodine are all found in the pulp of Allium sativum. It contains seventeen amino acids, including eight that are considered to be essential (Liu et al., 2020).

Given the nutritional benefits of garlic (*A. sativum*) bulb, notably the macronutrients, vitamins, and minerals it contains, the objective of this study was to evaluate the potential of garlic (*A. sativum*) bulb to be produced as a food supplement in two dosage forms: syrup and elixir. The nutritional contents, overall stability, and compatibility of the two garlic bulb preparations were compared to determine which dosage formulation will be best formulated as a food supplement. This study also aimed to provide a more enjoyable way of consuming garlic (*A. sativum*) by masking the unpleasant taste being experienced when ingesting raw garlic, particularly because it can cause disagreeable breath and is difficult to consume because of its pungent odor, without compromising its nutritional benefits.

II. METHODS

This study used a descriptive quantitative research design to examine the potential of garlic bulb as a food supplement from two dosage formulations: garlic bulb elixir and syrup. Five registered pharmacists were given a sensory evaluation form to score and evaluate the acceptability of the physical characteristics of both the garlic bulb elixir and syrup formulations through sensory observation after the products were formulated and quality control tests were completed. Color, odor, and appearance were assessed for both formulations while the quantitative measurement of macro and micronutrient conten was done in DOST region 2.

A. Collection of Plant Sample

Garlic (*A. sativum*) plant sample was collected in a clean bag at Tuguegarao City's public market. The researchers brought the plant sample to the Department of Agriculture located in Carig Sur, Tuguegarao City for the authentication of Garlic (*A. sativum*).

B. Preparation of Plant Extract

Five kilograms of garlic (*A. sativum*) bulbs were peeled, and each garlic clove was sliced with a knife before being dried in a microwave (40°C for 4-6 hours) and ground into a powder with a mortar and pestle. The powdered garlic was soaked in 80% ethanol in a clean Erlenmeyer flask. The container and its contents were sealed with a cotton plug and aluminum foil and left for 15 days to allow complete separation of the soluble components of the garlic extract throughout the soaking period, with occasional shaking and stirring. The extracted samples were filtered using Whatman No. 1 filter paper. The solvents were evaporated using a rotary evaporator at 40 °C under reduced pressure. A flame test was performed to ensure that the ethanol had thoroughly evaporated. The residues were stored in sterile amber bottles in the refrigerator until utilized (Bhatia et al., 2022).

C. Preparation of Dosage Form

a) Elixir. 7.5 mL of distilled water, alcohol, and glycerin were all combined. The compound orange spirit was added and then stirred. It was set aside with a cover for 24 hours. The liquid was filtered until it was clear after 24 hours. The sugar was added to the filtrate by stirring. Water was added until the desired volume was reached. The elixir base and garlic bulb extract were combined in an appropriate amount (Castillo et al., 2021).

b) Syrup. The amount of sucrose needed was weighed. The sucrose was placed in a bottle twice the size necessary for

syrup production. Continue to agitate until all of the sugar has been dissolved. More water was added to make the appropriate amount of syrup. The syrup base was combined with the necessary amount of extract and flavoring (British Pharmacopeia, 2021)

D. Quality Control Tests for Elixir and Syrup

a) Physicochemical characteristics. The garlic bulb elixir's and syrup's color, odor, appearance, clarity were evaluated using the senses. Five registered pharmacists evaluated the acceptability of the macroscopic characteristics of both formulations as supplements. The acceptability of each characteristic was scored from 5 being the highest to 1 being the lowest (Oladipo et al., 2022). pH was measured using a standard digital pH meter, viscosity was measured using a Viscotester RION VT-03F rotatory viscometer apparatus, specific gravity was measured using a Mohr-Westphal Balance (Keramatian et al., 2021). Alcohol determination was also done for the elixir using a pipet on suitable distillation equipment, and the temperature was recorded where the volume was determined.

b) Stability in different temperatures. For one week, each container of syrup and elixir was stored at 4°C in the refrigerator and 25°C at room temperature. For 1 hour, in the oven, a bottle of syrup and elixir was placed at 40°C. Five registered pharmacists evaluated the syrup's overall stability.

E. Qualitative and Quantitative Tests for Nutritional Content

The minerals, vitamins, and macronutrients of Garlic (*A. sativum*) bulb elixir and syrup were analyzed using the Official Method of Analysis of AOAC lnternational 21st Edition (2019). at the F.A.S.T. Laboratories (The First Analytical Services and Technical Cooperatives) located at Pandan, Angeles City, Pampanga. Fat, crude protein, total carbohydrate, energy values, and ash content, potassium and vitamin C were measured.

F. Data Analysis

The data was described using descriptive statistics, particularly the mean. The results were expressed by calculating the mean values of three samples of each formulation, garlic bulb elixir and garlic (*A. sativum*) bulb syrup, from each analysis. Each 5 mL sample will contain 0.5g of garlic bulb extract in both formulations. A t-test was used to assess the difference in the nutrient content of the two formulations. Additionally, the rubric assessment and weighted mean were used to determine the result of some quality control tests, particularly for the macroscopic evaluation of both the garlic (*A. sativum*) bulb elixir and the syrup. The resulting mean of the various parameters was analyzed and interpreted using the University likert scale, which is 4.50-5.00 considered as highly acceptable, 3.50-4.49 as acceptable, 2.50-3.49 as moderately acceptable, 1.50-2.49 slightly acceptable, and 1.00-1.49 as not acceptable. All data and information were collected to be tallied, tabulated, classified, analyzed, and interpreted.

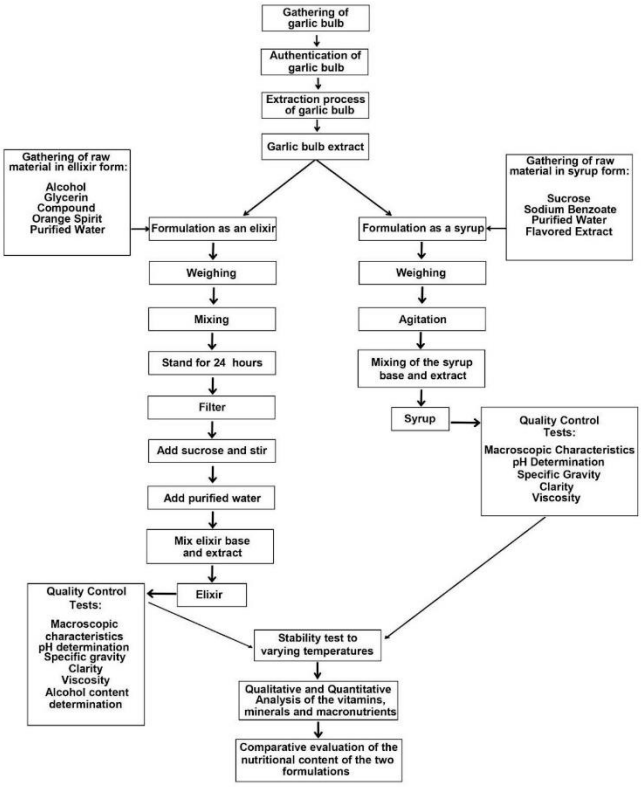

Fig. 1. Methodological framework followed in the conduct of the study

This flow chart depicts the general methods used by the researchers in the study to evaluate the potential of garlic (*A. sativum*) bulb formulated as a food supplement basing on the two dosage formulations that will be produced.

III. RESULTS AND DISCUSSION

Fig. 2. Final product developed

The formulated garlic bulb elixir is a clear sweetened hydro-alcoholic liquid with an orange flavor and strong alcoholic aroma with a faint of orange-like odor. On the other hand, the garlic bulb syrup is a slightly turbid viscous liquid with a lemon flavor and lemon-like odor.

TABLE I. CHARACTERISTICS OF GARLIC BULB (*A. SATIVUM*) SUPPLEMENT FORMULATED AS AN ELIXIR AND SYRUP

Parameters	Elixir		Syrup	
	Mean	***Qualitative Description***	***Mean***	***Qualitative Description***
Physical Characteristics				
Color	4.8	Highly Acceptable	4.6	Highly Acceptable
Odor	4.4	Acceptable	4.4	Acceptable
Appearance	5.0	Highly Acceptable	4.4	Acceptable
Overall Stability	4.73	Highly Acceptable	4.47	Acceptable
Clarity	5.0	Highly Acceptable	4.4	Acceptable
pH Level	6.79	Passed	6.68	Passed
Specific Gravity	1.16	Passed	1.26	Not passed
Viscosity	0.5 poise	Passed	0.25 poise	Passed
Alcohol Concentration	23.28%	Passed		
Stability				
At 40ºC	5.0	Highly Acceptable	5.0	Highly Acceptable
At 25ºC	4.4	Acceptable	4.4	Acceptable
At 4ºC	5.0	Highly Acceptable	5.0	Highly Acceptable

Table I shows that the physicochemical characteristics of the elixir and syrup dosage forms of the garlic bulb supplement are acceptable and have passed the set standards for these dosage forms.

Formulation quality control is critical in establishing the product formulation's safety and efficacy (Rezghi et al., 2019). It includes evaluating physical characteristics, which are regarded as one of the most significant indicators of potential customer preferences and are directly related to food product selection. In this regard, the macroscopic characteristics of both formulations, particularly odor, color, and appearance, were subjected to evaluation by five registered pharmacists. Based on the University scorecard, the mean of the findings in the different parameters was used to interpret the data, which is 4.50-5.00 considered as highly acceptable, 3.50-4.49 as acceptable, 2.50-3.49 as moderately acceptable, 1.50-2.49 slightly acceptable, and 1.00-1.49 as not acceptable. In terms of color, the results showed that elixir (average weighted mean of 4.8) and syrup (average weighted mean of 4.6) were both rated highly acceptable. According to the ratings, the syrup and elixir attained color uniformity and consistency, which were similarly concluded for other formulations such as the blueberry syrup formulated, which were both satisfactory according to standards.

For odor, both formulations obtained a weighted mean of 4.4, which is deemed acceptable. Based on the evaluation, the syrup and elixir have a light odor that is not unpleasant and is not developed by the garlic smell. To improve the palatability and odor of oral dosage forms, flavorings such as grape essence, lemon flavoring, caramel cream scent, or orange essence are utilized (Rouaz et al., 2021). As a result, the flavoring ingredients, which were the compound orange spirit for the elixir and lemon flavorant for the syrup, effectively masked the strong pungent smell of garlic in both formulations. Lastly, in terms of appearance, the elixir received a weighted mean of 5, indicating that it is more highly acceptable than the syrup, which received a weighted mean of 4.4, indicating that it is only acceptable. The score suggests that the elixir was more absolutely uniform than the syrup, but neither formulation exhibited evidence of crystallization and sedimentation. This is roughly in line with the criteria for dry syrup appearance, which had a good appearance with absence of deposits (Sidiki et al., 2018).

So, for overall stability, the elixir received an average weighted mean of 4.74 based on the three formulation parameters described above, which indicates that it is more physically stable than the syrup, which received only a 4.47 average weighted mean. Moreover, clarity is one of the quality parameters being assessed. In the studies of the paracetamol elixir and salbutamol syrup, a clear solution with no presence of foreign particles indicates consistency and stability (Huraira et al., 2018; Tirunagari et al., 2020). In lieu with the study we conducted, our finding shows that elixir's clarity appears more acceptable than syrup's clarity, with an average weighted mean of 5.0, interpreted as highly acceptable compared to the average weighted mean of the latter (4.4). Based on the mean scores, the elixir formulation was more clear and consistent than the syrup, although neither contained any solid particles in the preparation.

Furthermore, except the specific gravity parameter solely for the syrup formulation, the results of other quality control tests for both formulations were satisfactory and in conformity with the official standards specified in pharmacoepoeias. The results revealed that the syrup, with specific gravity values of 1.26 fell short of the criterion of not less than 1.30 for syrup. The specific gravity is calculated by dividing the weight of a liquid in the air at 25°C by the weight of an identical volume of water at the same temperature (USP, 2019). As a result, variations in temperature, or failure to regulate it, can modify the density of liquids, influencing their specific gravity. This could be one of the explanations as to why the syrup formulation failed to fulfill the standards. However, syrups which have density of 1.07, 1.048, 1.27, which is equivalent to its specific gravity, have been concluded acceptable regarding the physical parameters (Zakerin et al., 2019; Rezghi et al., 2019; Sidiki et al., 2018).

On the other hand, no precise standard value is defined in different pharmacopoeias for the elixir formulation's specific gravity. The specific gravity values of various elixirs available on the market also differ. For example, the siddhalepa ayur elixir, which is available for purchase in India, has a lower specific gravity value than the dexamethasone elixir, which is 1.03 and 1.116 specific gravity values, respectively (Darvin et al., 2019; Rosas, 2021). Additionally, since a compound's specific gravity is influenced by the relative quantities and densities of its constituents, various substances possess different densities, and when mixed in specific proportions, they contribute to the total density of the compound. As a result, the specific gravity of the elixir is 1.16. was deemed acceptable. However, in terms of pH, the elixir and syrup, with pH levels of 6.79 and 6.68, were within the accepted range of 6-7. Also,

the viscosity of both formulations passed the established limits of 0.245 poise for syrup and 0.5-6.0 poise for elixir. The alcohol content determination, which is solely applicable to the elixir, likewise passed the 4-40% standard, with 23.28% being within that range. The alcohol content in elixirs works as a preservative and promotes formulation stability, hence, preservatives are not required (Darvin et al., 2019).

When exposed to varied temperatures, the two formulations had no significant difference. Following evaluation, both formulations got a weighted mean of 4.4 (acceptable), 5 (highly acceptable), and 5 (highly acceptable) for overall stability at room temperature (25 C), refrigerator (4 C), and oven (40 C), respectively. The rating indicates that both of the products were satisfactory in terms of temperature stability upon evaluation, considering that adding preservatives significantly impacts the product's shelf life and customer acceptance. However, the mean values were lower at room temperature than on refrigerator and oven. Food and other pharmaceutical products are becoming potentially harmful and unstable due to poor and unsanitary handling and storage conditions, as well as a lack of sufficient temperature control. As a result, considering the temperature in the refrigerator and oven is more regulated than the temperature in the room, which varies every time, this explains why the overall stability evaluated for products stored in the oven and refrigerator was greater. The sensory ratings of a syrup formulation decreased less at refrigerated temperature than at room temperature (Dongare et al., 2019). Furthermore, physical stability revealed that another polyherbal syrup was stable with no development of pathogenic microbes when exposed to 4°C in a refrigerator and 40°C in an incubator (Zakerin, 2019).

TABLE II. NUTRIENT COMPONENTS OF GARLIC BULB (*A. SATIVUM*) SUPPLEMENT IN ELIXIR AND SYRUP FORMULATION

Parameters	Elixir		Syrup	
	100 grams (10mL extract)	***5 grams (0.5mL extract)***	***100 grams (10mL extract)***	***5 grams (0.5mL extract)***
Moisture	40.6g	2.03g	36.6g	1.83g
Total Fat	0.0714g	0.00357g	0.0191g	0.00455g
Crude Protein	Less than 0.0875g	Less than 0.004375g	Less than 0.0875g	Less than 0.004375g
Total Carbohydrates	59.2g	2.96g	63.3g	3.165g
Energy Value	0.237kcal	0.01185kcal	0.253kcal	0.01265kcal
Ash Contents	0.07g	0.0035g	0.091g	0.00455g
Mineral (Potassium)	9.47mg	0.4735mg	11.7mg	0.585mg
Vitamin (Ascorbic Acid)	Less than 0.5mg	Less than 0.025mg	Less than 0.5mg	Less than 0.025mg

Table II shows the result of the qualitative and quantitative tests conducted for both formulations per 100g and 5g of the product containing 10mL and 0.5mL of the garlic bulb extract, respectively. This indicates that the nutrition values of the syrup formulation for carbohydrate, energy, potassium, and ash content were higher than those of the elixirs except for fat and moisture content, in which the latter was greater than the former. However, both formulations obtained similar values for protein and vitamin C content.

TABLE III. SIGNIFICANT DIFFERENCE IN THE NUTRIENT COMPONENTS OF GARLIC BULB (*A. SATIVUM*) SUPPLEMENT FORMULATED AS AN ELIXIR AND SYRUP

t-Value	p-Value	Decision
.025	0.981	Accept Ho

* *SIGNIFICANT AT 0.05 LEVEL*

As shown in the table, there is no significant difference in the nutrient contents of garlic bulb (*A. sativum*) supplement formulated as an elixir and syrup. This means the nutritional composition of elixir and syrup garlic bulb supplements is relatively the same. However, the mean nutrient content of the syrup garlic bulb supplement is higher than the elixir garlic bulb supplement.

The nutrient content of the elixir and syrup is given in Table II. Each 5mL of syrup formulation with 0.5g of garlic extract had higher carbohydrate and calorific value (3.165g and 0.01265kcal) than the elixir (2.96g and 0.01185kcal). The carbohydrate value of 0.5g raw white garlic was determined to be 0.1215g and 0.14g, however both were lower when compared to the syrup and elixir (Botas et al., 2019). Sucrose is a carbohydrate source and an avenue of accessible energy (Prechtl et al., 2018). Since the sucrose concentration of the syrup (66.7%) is substantially higher than that of the elixir (32%), this explained why the syrup has a greater amount of carbohydrate and calorific value. This also holds true for the carbohydrate content of raw white garlic, which are significantly lower in both formulations due to the absence of excipients and additives. However, the latter had higher fat content (0.00357g) than the former (0.000955g). Conversely, elixir contains compound orange spirit as a flavoring component, which is an alcoholic mixture including orange, lemon, coriander, and anise oils (USP, 2019). Coriander and anise oil are both regarded sources of high-value lipophilic bioactive compounds, which is why the elixir contains more fat than syrup (Balbino et al., 2021). Additionally, according to studies on the nutritional makeup of garlic, the fat concentrations of raw garlic were 0.00115g and 0.00235g (Botas et al., 2019). These figures are lower than the elixir's fat content because of the oils present, which contribute to its fat content, but greater than the syrup's fat content.

Similarly, the potassium contents of the syrup (0.585mg) were greater than that of the elixir (0.4735mg), while their protein and vitamin C content was comparable (both less than 0.004375g and less than 0.025mg). Raw garlic has a much greater protein, potassium, and vitamin C content than both formulations, with 0.0215g and 0.0325g for protein, 2.23mg for potassium, and 0.07 for vitamin C in the same concentration (Botas et al., 2019). Heat processing can result in the loss of vitamins, natural antioxidants, and minerals (Lima et al., 2018). As a result, since the extraction process for both formulations entails drying the raw garlic, heat exposure might be one of the causes contributing to the reduced vitamin and mineral amounts of both formulations. To support, other products, such as raw cassava root, which contains high vitamin C, result in vitamin

content loss since the vitamin is heat sensitive and leaches into water (Abraha et al., 2019).

The syrup's ash content (0.00455g) was also more significant than the elixir's (0.0035g). In general, food with a high ash content contains an extensive quantity of minerals including calcium, magnesium, potassium, and phosphorus (Amini Khoozani et al., 2020). Since the concentration of potassium in syrup (0.585mg) was found to be greater than that of elixir (0.4735mg), it has a higher ash content than the latter. Similarly, the ash amount in raw white garlic was 0.0115g, which was considerably greater than the ash content of both formulations, considering that it also has a higher potassium content (2.23mg) than both formulations. However, the syrup's moisture content (1.83g) was lower than that of the elixir formulation (2.03g). The determination of a food's water or moisture content, as well as its dry matter or total solids, is important not only for providing a basis for demonstrating the content of the other components on a wet- or dry-basis, yet additionally for food stability and quality. Considering the elixir formulation had more purified water due to its lower sucrose concentration (32%), compared to the syrup formulation (66.7%) with a higher one, this explains why the syrup had a lower moisture content than the elixir. Aside from that, numerous studies have found raw garlic to have moisture content levels of 0.35g and 0.31g (Botas et al., 2019). Given that no more water was added; these values were significantly lower than those of the other formulations.

Given these values, there is no significant difference in the nutrient contents of garlic bulb (*A. sativum*) supplement formulated as an elixir and syrup. This means that the nutritional composition of elixir and syrup garlic bulb supplements is relatively the same. However, the mean nutrient content of the syrup garlic bulb supplement (0.703) is higher than the elixir garlic bulb supplement (0.689). According to FDA Philippines Officer Order No. 22 s. A product can be categorized as a food supplement if it meets the following criteria: its indication is "Dietary or Health Supplement"; its concentration per dosage form is less than 105% of the PDRI for fat-soluble vitamins and/or less than 150 percent for water-soluble vitamins; it is available in both non-pharmaceutical and pharmaceutical dosage forms, except parenteral; it is available as either a purified or a natural product; and it contains no additional pharmacologically active ingredients (FDA, 1991). To emphasize, for the second specified criterion, since the water-soluble vitamin, vitamin C, had a content of less than 0.025mg in both formulations, this value qualifies for the aforementioned criteria because the value is less than 150 percent for the water-soluble vitamins. Since both formulations met the above-mentioned criteria, garlic bulb elixir and syrup have the potential to be used as a food supplement.

However, the study's findings were limited to the nutritional content, stability, and physical characteristics of the garlic bulb in liquid formulations, specifically syrup and elixir, and no tests were performed for any garlic bulb formulated into different solid formulations or dosage forms. Given the nutrients found in the garlic bulb food supplement, no tests were conducted to determine its effectiveness in supplementing the diet as well as fulfilling their defined supplement claims, such as blood cholesterol-lowering action (Emamat et al., 2020), anticancer (Miraghajani et al., 2018), and antidiabetic effects (Qais et al., 2018). Aside from that, the nutrient content per dose, which was limited to 0.5g of garlic extract per 5mL, was not very substantial, necessitating a higher concentration of garlic extract per dose. Moreover, only the mineral potassium and vitamin C content were being determined for the nutritional composition of both formulations, though other minerals (Phosphorus, Magnesium, Sodium, Calcium, Iron, Zinc, Iodine, and Selenium) and vitamins (Thiamine, Riboflavin, Niacin, Pyridoxine, Folic Acid, Carotenoids, Vitamin A, and Vitamin E) were also present in the nutritional composition of raw white garlic in a study presented in Table 1.

IV. CONCLUSION

This study was performed to throw light on the potential of garlic (*A. sativum*) bulb to be formulated as a food supplement from two different dosage forms: elixir and syrup, by comparing the number of its nutritional contents (vitamins, minerals, and macronutrients), as well as its product quality and stability after being formulated as a pharmaceutical product. In accordance with the findings, both formulations are acceptable in terms of quality. Still, elixir appears more acceptable in terms of the product's physical characteristics such as color, odor, and appearance. Both formulations' stability revealed no significant differences when subjected to varied temperatures, although both were acceptable. Similarly, there is no significant difference in the nutrient contents of garlic (*A. sativum*) bulb supplements manufactured in elixir and syrup formulations. However, the syrup formulation has comparatively higher nutrient values than the latter. As a result, whether manufactured as a syrup or an elixir, garlic bulb is suitable in terms of quality, stability, and nutrient content, so it has a potential for formulation as a food supplement.

V. RECOMMENDATIONS

Based on the study's findings, the following recommendations are made for the future development of the potential of garlic (*A. sativum*) bulb to be developed as a food supplement.

- To assess the efficacy of the developed products as a food supplement in individuals, as well as their effectiveness in carrying out their established supplement claims (e.g., cholesterol lowering effect).
- To compare the nutrient content, quality, and stability of garlic bulb formulation as a solid dosage form to the findings of the liquid equivalent formulation.
- To identify and quantify other minerals and vitamins other than potassium and vitamin C that had not been assessed on both formulations.
- Since vitamins and minerals are heat sensitive, change the extraction process to one that does not require heat.
- If the researchers want to increase the amount of macronutrients, vitamins, and minerals in the preparations, they should increase the volume of extract needed.

- Collaboration with Batanes LGU to explore the use of garlic locally grown in the region as a source of raw materials. This can also promote agricultural productivity related to this crop and can support sustainability of this product for commercialization.
- Partnership with PITAHC and DOST can be done to determine ways on how to start-up the commercialization of this product.

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