

Effectiveness of purple cabbage-based slimming diets in people with obesity from the Cleotilde Guerrero O Foundation.

Efectividad de dietas adelgazantes a base de col morada en personas con obesidad de la Fundación Cleotilde Guerrero O.

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Abstract.

This study demonstrated the benefits of weight-loss diets based on red cabbage, known for its phytochemical and antioxidant content, and considered a potentially beneficial source for weight loss and improved metabolic health. The objective was to evaluate the effectiveness of red cabbage-based weight-loss diets in obese individuals at the Cleotilde Guerrero O Foundation in Guayaquil, Ecuador. The research was conducted using a quantitative approach and a quasi-experimental design. Participants with significant obesity followed a dietary program focused on incorporating red cabbage into their daily diet. The results revealed that the red cabbage-based weight-loss diets had a positive impact on weight loss. A significant decrease in body mass index (BMI) and waist circumference was observed, suggesting a beneficial effect on cardiovascular and metabolic health. This study supports the idea that red cabbage may play an important role in weight-loss diets for obese individuals. However, further research is needed to fully understand the mechanisms behind these effects and to determine optimal red cabbage consumption guidelines in weight-loss programs. This study at the Cleotilde Guerrero O Foundation indicates that diets incorporating red cabbage may be effective in helping obese individuals lose weight and improve their metabolic health.

Keywords.

Weight loss, body mass, metabolism, nutrition, obesity, health.

Resumen.

El presente estudio permitió demostrar los beneficios de las dietas adelgazantes basadas en la col morada conocida por su contenido de fitoquímicos y antioxidantes, se considera una fuente potencialmente beneficiosa para la pérdida de peso y la mejora de la salud metabólica. El objetivo es evaluar la efectividad de las dietas adelgazantes elaboradas a base de col morada en personas con obesidad de la Fundación Cleotilde Guerrero O de la ciudad de Guayaquil. La investigación se efectuó a través de un enfoque cuantitativo y un diseño cuasi experimental e incluyó a un grupo de participantes con exceso de obesidad que fueron sometidos a un programa de dieta que se centró en la incorporación significativa de col morada en su alimentación diaria. Los resultados revelaron que las dietas adelgazantes basadas en la col morada tuvieron un impacto positivo en la pérdida de peso de los participantes. Se observó una disminución significativa en el índice de masa corporal (IMC) y la circunferencia de la cintura, lo que sugiere un efecto beneficioso en la salud cardiovascular y metabólica. Este estudio respalda la idea de que la col morada puede desempeñar un papel importante en las dietas adelgazantes para personas con exceso de obesidad. Sin embargo, se requieren investigaciones adicionales para comprender completamente los mecanismos detrás de estos efectos y para determinar las pautas óptimas de consumo de col morada en programas de pérdida de peso. Este estudio en la Fundación Cleotilde Guerrero O indica que las dietas que incorporan la col morada pueden ser efectivas para ayudar a las personas con exceso de obesidad a perder peso y mejorar su salud metabólica.

Palabras clave.

Adelgazar, masa corporal, metabolismo, nutrición, obesidad, salud.

1.- Introduction

Obesity is a disease that is characterized by an excess of body fat that affects the physical and psychological health of individuals. It is usually measured through the body mass index (BMI), which relates the weight and height of a person, a person is considered obese if their BMI is equal to or greater than 30 kg/m². On the other hand, this problem is not simply cosmetic, but a major risk factor for a number of chronic diseases, including type 2 diabetes, cardiovascular disease, hypertension, and certain cancers. In addition,

obesity can lead to reduced quality of life and increase healthcare costs associated with treating your comorbidities. [1][2][3]

Obesity has become an epidemic that affects the whole world, even more so developed or developing countries, becoming a burden on society because they exceed one billion cases according to the latest epidemiological studies, that is, today there are many more people with excess body weight than in ancient times. where there was greater

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physical activity because individuals were engaged in activities such as the house and gathering that demanded more energy and a lower intake of food, where this was done to survive.[4]

In recent years, it has become a global public health problem that has reached epidemic proportions. In 2022, about 890 million people were obese, which corresponds to 16% of the population, in 2024, 35 million school-age children were part of this condition. 60% of the adult population and 33% of children and adolescents in Latin America and the Caribbean were obese in 2025, tripling since 1975. While, according to the Global Nutrition Report, in Ecuador more than 27% of women and 17% of men suffer from this disease. This [5] [6][7]condition is associated with an increased risk of chronic diseases, such as type 2 diabetes, cardiovascular disease, and certain cancers, What it requires Ongoing medical care and follow-up to improve the quality of life of affected individuals.[8]

Obesity has become one of the most pressing public health challenges worldwide. As obesity rates continue to rise, the relationship between obesity and these adverse health conditions has been documented in numerous epidemiological and clinical studies, underscoring the urgent need to address this global health issue. Given the growth of cases in recent years, it has been considered [9]treatments to reduce obesity, focusing in a variety of approaches, including diet modification, increased physical activity, behavioral therapy, and in some cases, bariatric surgery. In this context, slimming diets have become a commonly employed strategy for obesity management, and ongoing research seeks to identify foods and dietary patterns that can improve the effectiveness of these programs [10].

Slimming diets usually involve the controlled modification of caloric intake, resulting in a caloric deficit that leads to weight loss. These can vary in terms of nutritional approach, and can be low-carb, low-fat, based on specific dietary patterns (such as the Mediterranean diet or the ketogenic diet), or incorporate specific foods and nutrients with promising properties for weight loss and metabolic health. As food programs designed to promote weight loss in overweight or obese people, they often involve calorie restriction, portion control, and food selection with the goal of creating a caloric deficit, leading to loss of body fat. These can vary widely in terms of nutritional composition and approach, from low-carb diets to low-fat diets to diets based on specific eating patterns.[11][12]

However, slimming diets cannot be applied in all cases, since, in order to be implemented, they must have guidance from professionals in the area of health and nutrition due to the presence of physiological, metabolic and clinical conditions that determine in which cases this type of nutritional intervention can be performed. Additionally, it is pertinent to consider aspects such as age, medical history,

physical activity levels, nutritional requirements, so targeted planning is required to reduce measures in a personalized way. In this sense, the supervision of a professional is necessary to ensure that the dietary plan is adequate, balanced, safe, especially aligned with the needs of the patients. On the other hand, a constant evaluation of the progress made is required to avoid possible nutritional deficiencies that favor healthy and sustainable results.

One of the Emerging proposals for weight loss, It is the exploration of specific foods and their bioactive components that can have a positive impact on weight reduction and improved metabolic health. In this search for effective strategies to combat obesity, phytonutrients, bioactive compounds present in a variety of plant foods, have emerged as an area of growing interest in research. These compounds have been shown to have a number of beneficial health properties, including antioxidant, anti-inflammatory, and potentially anti-obesity effects. Plant-based diets provide necessary calories, carbohydrates, proteins, and fats. As well as prebiotic fibers and phytochemicals that have an antioxidant effect and several of them are cardioprotective. [13][14]

The exploration of specific foods and bioactive components are part of a relevant line of research in engineering, chemistry and gastronomy that allows the development of nutritional strategies aimed at weight control where the chemical composition of the food, the transformation processes and the stability of the functional compounds that are found. In vegetables, they are used in a timely manner. While, from the gastronomic perspective, knowledge is obtained of the correct ways to prepare, preserve and consume food for the total use of the compounds in this sense. The study of vegetables is of vital interest, due to the anthocyanin fibers and polyphenols that regulate metabolism and reduce fats in the body.

One of the beneficial foods, which serves the purpose of reducing body fat and regulating metabolism, is purple cabbage (*Brassica oleracea* var. *capitata* f. *rubra*), also known as red cabbage or purple cabbage, due to its high content of phytochemicals and antioxidants, such as anthocyanins and flavonoids have been shown to have beneficial properties for health, including anti-inflammatory and antioxidant effects. In addition, this vegetable is a natural source of anthocyanins and other phytonutrients, it has stood out as a promising candidate to be incorporated into slimming diets. [15]

The analysis of the literature allows us to know the impact of anthocyanins on weight loss and improvement in metabolic health, reports heterogeneous results. Some studies argue that those foods that have this component lead to reducing body measurements and minimizing inflammation, others indicate that consumption does not generate a significant impact on daily calorie intake or lifestyle changes. However, they agree that foods

containing anthocyanins have properties that regulate metabolism and antioxidants. [16]

The anthocyanin found in purple cabbage regulates energy metabolism, because the AMP-activated protein kinase (AMPK) is an enzyme that generates a cellular energy balance that oxidizes fatty acids and minimizes lipids, although these are not always associated with weight loss. On the other hand, this compound influences the receptor activated by gamma peroxisome proliferators (PPAR- γ), which is the cause of adipose tissue storage, which shows a regulatory effect on lipid metabolism. [17] [18]

In addition, anthocyanin is relevant to antioxidant activities because it reduces oxidative stress and chronic inflammation in the body that goes hand in hand with insulin resistance and is reflected in obesity. So this component of purple cabbage is part of the reactive oxygen species and regulates metabolism, accesses glycemic control with the activation of AMPK. It is necessary to consider the methods of consumption, dosage and characteristics of the population. [19]

In human studies, it has been proven that anthocyanins are one of the compounds in purple cabbage, which provides the necessary nutrients to achieve satiety and weight loss. However, its stability is limited to its stability, which is affected by temperature, because high temperatures generate degradation, that is, the loss of color and minimize its antioxidant properties. Therefore, the way it is cooked has a significant impact, therefore, it is recommended to consume this food steamed or sautéed to preserve its nutrients. In the case of consuming savory cabbage with vinegar or lemon dressing, it allows it to maintain its intense tones and greater stability. [20]

However, despite the fact that there are functional foods that reduce obesity through the nutrients of vegetables, as is the case of purple cabbage, which is supported by some studies where the presence of bioactive compounds is identified, there is still a scarcity of research applied to specific cases where the impact of dietary programs aimed at a specific segment of the population with obesity is analyzed. It supports the need to develop detailed studies that allow an accurate evaluation of the effects of cabbage consumption based on the consideration of anthropometric and metabolic indicators that contribute to evidence the potential of this food as a natural and functional nutritional strategy for weight control.

This research aims to evaluate the effectiveness of slimming diets made from purple cabbage in people with obesity from the Cleotilde Guerrero Foundation O in the city of Guayaquil. Specifically, the variation in body weight (kg) with the nutritional intervention based on the consumption of purple cabbage was determined, the change in the body mass index (BMI) in the morbidly obese population was assessed with the application of the nutritional plan, and the reduction of abdominal circumference (cm) was associated with the reduction of body fat.

In this context, the present study, carried out at the Cleotilde Guerrero O Foundation, aims to address this gap in knowledge. Through a carefully designed research design, the effectiveness of slimming diets made from purple cabbage in people with excess obesity will be evaluated. The results of this study are expected to provide insight into the usefulness of purple cabbage as a dietary component in the management of obesity and its potential benefits for metabolic health. Research in this area has the potential to offer more effective and personalized strategies to address the growing obesity epidemic and its consequences for public health and people's quality of life

This research is justified based on methodological feasibility due to the scientific contribution made in the field of nutrition and functional foods. anti-inflammatory processes generating visible and significant improvements in health indicators. [21]

In the specific case of developing research in Cleotilde Guerrero O, which frequently presents people with obesity problems, it entails implementing periodic monitoring of the participants and obtaining relevant information that in its analysis allows understanding the effects of the nutritional intervention. Likewise, to provide empirical evidence about the potential of vegetables in slimming diets and to integrate knowledge in nutrition, gastronomy and chemical engineering to highlight the functional properties of foods and their application in programs that promote health.

2.- Materials and methods.

The research was carried out through a quantitative approach and a longitudinal quasi-experimental design with pre-test-post-test measurements, in order to evaluate the effects of the purple cabbage-based slimming diet considering people with obesity. This design allows us to know the changes that occur in certain aspects, before and after the nutritional intervention in order to compare the results obtained at different times during the research process. It is important to note that the study is carried out in the context of a nutritional support program, aimed at people who are obese, therefore, healthy food strategies were implemented, such as the consumption of natural foods that have a functional potential.

This study was carried out as a pre-test-post-test clinical trial without a control group to investigate the effectiveness of slimming diets made from purple cabbage in people with obesity: a study carried out at the Cleotilde Guerrero O Foundation, with a study population were selected from those who sought medical attention at the Sra. Cleotilde Guerrero O Foundation in the Isla Trinitaria sector, Guayaquil corresponds to 50 adults, mostly diagnosed with morbid obesity, aged between 30 and 65 years. However, the sample to carry out the intervention was reduced to 15 people, due to aspects such as: voluntary abandonment of

the process, non-attendance at controls and non-compliance with the inclusion criteria that refer to non-compliance with the meal plan. In such a way, a probabilistic sample was considered for convenience.

It should be noted that the sample was not calculated formally, which generates limitations in the conduct of the study and may affect the representativeness of the results and their generalization.

The inclusion criteria allowed considering adults who currently have a diagnosis of obesity according to the body mass index, According to the parameters established by international health organizations in adults, it corresponds to values equal to or greater than 30 kg/m². To the same extent, fundamental ethical aspects are taken into consideration, informed consent for the performance of the evaluations scheduled in the intervention periods, and the confidentiality of the data obtained. In the characterization of the sample, demographic variables were considered, such as age and gender of the participants, which allowed an analysis to be carried out based on the distribution according to the age group to know the influence on metabolic behavior and the response of the organisms to the nutritional intervention aimed at losing body weight.

Anthropometric variables were considered, which allow evidence of the nutritional status and body composition of the participants, such as body weight, height, body mass index and abdominal circumference using balanced digital scales with a capacity of up to 150 kg and accuracy equal to or greater than 0.1 kg in order to guarantee the accuracy of the values obtained. the same that were obtained in the morning hours using light clothing. Meanwhile, the height was obtained through a height meter with an accuracy equal to or greater than 0.1 cm where the participants were placed in an upright position and with their feet together, as part of the protocols for anthropometric measurements to be classified in a category:

Table 1 Body mass index

IMC MIN	IMC MAX	Category	Nutritional Diagnosis
0	18,49	Low weight	---
18,5	24,99	Normal	Q---
25	29,99	Overweight	---
30	34,99	Mild Obesity	1
35	35,99	Medium Obesity	2
40	From now on	Morbid Obesity	3

Source: Data obtained from Vinueza et al., 2023 .[22]

The values obtained in the measurement of weights and heights allowed the calculation of the body mass index, which is one of the indicators used to determine the

nutritional status in adults, for which the relationship of weight in kilograms and the square of height expressed in meters was considered, as shown in the equation:

$$\text{BMI} = \text{weight (kg)} / \text{height}^2 (\text{m}^2) (1) \text{ , [23] [24]}$$

The abdominal circumference was obtained with the help of a flexible anthropometric tape measure that is placed in the abdominal region at the level of the navel where the participants are standing and breathing normally. This variable is important because it is one of the indicators that allows evidence of the accumulation of abdominal fat associated with a significant risk of metabolic and cardiovascular diseases. The procedure was carried out considering several moments of assessment. The first control was carried out in August where the demographic, anthropometric and laboratory variables referred to in the initial measurement are recorded.

After the collection of information, the nutritional plan based on purple cabbage was designed, it is prepared considering data such as weighing and measurement considering that it is mostly corresponding to an older adult population, where other foods such as: carbohydrates, vegetables, fats and fruits are combined to achieve a balance in the daily diet. However, the protagonist is red cabbage in various presentations, raw in salad or steamed, sautéed, creams and soups integrated into lunch and snacks that corresponds to a daily consumption of 150gr – 250gr/day that refers to one or two cups that provide the fiber that the body requires for optimal digestion, it generates satiety and favors the caloric deficit that it requires to reduce measures.

Table 2 Purple cabbage-based nutritional plan

	Breakfast	Mid-morning	Lunch	Mid-afternoon	Snack
Monday	1 cup oatmeal in water 4 pieces of papaya	1 green apple	60gr of grilled chicken1 cup of red coleslaw 1/2 cup of brown rice	1 x 250ml glass plain yogurt	250 ml red cabbage cream1 Cooking egg
Tuesday	1 cooked egg2 slices whole-grain toasted bread1 cup tea	1 pear	60 gr of grilled or steamed fish2 cup of red cabbage with lemon dressing.1 small potato, cooked.	1 cup tea 2 wholemea 1 crackers	1 cup of purple coleslaw6 0 gr of tuna in water
Wednesday	1 cup cooked lentils1 cup red coleslaw.	1 small banana	1 cup cooked lentils1 cup red coleslaw.	1 green apple	1 cup red cabbage1 cup shredded chicken cooked in water.

Thursday	60 gr of stewed meat1 cup of red cabbage	1 orange	60 gr of stewed meat1 cup of red cabbage	1 cup of yogurt	250 ml red cabbage soup with vegetables
Friday	250 ml red cabbage cream	4 pieces of papaya	60 gr of tuna in water1 cup of purple coleslaw1 cup of brown rice	1 cup tea2 Whole-grain crackers	250 ml red cabbage cream
Saturday	1 cup red cabbage salad1 scrambled egg	1 green apple	60 gr of stewed chicken1 cup of red cabbage1 small cooked potato	1 cup chamomile tea	1 cup red cabbage salad1 scrambled egg
Sunday	1 cup oatmeal in water1 small banana	4 pieces of melon	60 gr of baked fish1 cup of red cabbage1 cup of brown rice	1 cup of yogurt	250 ml red cabbage soup with vegetables

Source: This nutritional plan is adapted to the needs of the participants of the Cleotilde Guerrero O Foundation, which is kept under pressure and glucose monitoring. The duration is 4 weeks, so it is suggested that in week 2 – 4 the participant can continue with the same sequence, or vary the days without repeating the same days during the week.

Additionally, necessary eating habits such as portion control and consumption of natural foods were generally recommended to achieve greater adherence of the participants to the established diet. The second assessment will be carried out in September to record updated information regarding anthropometric and laboratory variables, which allow comparison with the results obtained at the beginning and to know the variation between before and after the implementation of the diet based on the consumption of purple cabbage. This will allow us to know if changes were obtained in terms of body weight, body mass index, abdominal circumference.

Although the consumption of the foods established in the nutritional plan is carried out, where the daily consumption of purple cabbage is emphasized, there was no strict control of the daily caloric intake of the participants, nor a detailed record of the macronutrients, the intervention emphasizes the integration of cabbage as a functional food in a balanced diet. Therefore, the results obtained can not only be influenced by the consumption of this vegetable but also by the total energy consumption.

The reliability of the anthropometric measurements: standardized procedures were carried out to carry out the process of reconnecting information, that is, before carrying out the measurement, the equipment that would be used to carry out the activities was verified and calibrated. On the other hand, the participants were evaluated under similar

conditions. That is, considering similar schedules in the control sessions to avoid alterations in the results, as well as the immediate intake of food or the performance of some intense physical activity that may affect the evaluation.

It is important to note that the measurements were carried out with the help of personnel trained in the area and following the relevant protocols for anthropometric studies in adult participants in order to reduce errors in the measurement and ensure that the data collected are consistent in the different phases.

The data obtained were recorded in a database with the help of the Microsoft Excel office automation tool to initially process the information collected, the review and purification of the recorded data was carried out before carrying out the statistical processing. The class classification of the information according to the demographic and anthropometric variables in order to facilitate the analysis and interpretation of them, this allowed the information to be structured in an orderly and systematic manner.

Next, a statistical analysis was carried out in Microsoft Excel where descriptive statistics were considered for the analysis of demographic and anthropometric variables to compare the values obtained initially and finally to make a diagnosis and identify changes in the evaluated indicators. The limited duration of the study was recognised as a possible limitation and the need for long-term follow-up to better understand the effects of slimming diets made from purple cabbage.

The ethical considerations that were taken into account for the collection of information and development of this research process are framed in the ethical principles established for research with the help of human beings, where those who participate were informed about the objectives and steps to be developed, they agreed to participate voluntarily, in addition the confidentiality of the data obtained was guaranteed, which will be used for scientific and academic purposes. To the same extent, the Cleotilde Guerrero O Foundation authorized the study to be carried out at its facilities

3.- Results.

The results obtained considered demographic, anthropometric and biochemical variables, carried out with the help of the participants of the Cleotilde Guerrero Foundation. The sample was made up of 15 people who mostly have obesity problems and participated in the first assessment corresponding to August 31, 2023 in the morning, which led to obtaining the following information:

Table 3 Initial evaluation of participants

Partic.	Age	Date of Birth Y-MM-DD	Weight (Kg)	Size (Mts)	Waist circumference (cms)
P1	57	1965-07-18	87,70	1,56	108,00
P2	32	1990-01-06	74,84	1,41	102,00
P3	40	1981-12-20	84,37	1,54	104,00

Partic.	Age	Date of Birth Y-MM-DD	Weight (Kg)	Size (Mts)	Waist circumference (cms)
P4	51	1971-07-30	81,64	1,43	102,00
P5	56	1966-08-12	81,65	1,51	98,00
P6	48	1973-12-12	75,75	1,53	96,00
P7	62	1960-05-21	84,75	1,70	107,00
P8	63	1959-07-20	70,76	1,59	88,00
P9	56	1965-11-28	56,70	1,41	94,00
P10	48	1973-10-17	86,50	1,43	114,00
P11	27	1995-06-02	67,10	1,48	81,00
P12	25	1998-05-22	93,89	1,59	105,00
P13	53	1970-11-27	57,60	1,55	108,00
P14	52	1963-04-18	63,50	1,50	88,00
P15	52	1971-04-07	100,24	1,48	107,00

Source: data obtained during the sizing and weighing of the participants of the Cleotilde Guerrero O Foundation, dated August 31, 2023.

The database specifies the values obtained during the initial data collection process such as: age, date of birth, sex, weight, height and abdominal measurements of each of the participants. The same ones that allowed us to generate a comprehensive vision of the conditions in which the patients of this foundation were before the implementation of the purple cabbage in their daily food plan. It was found that 93.33% of the participants correspond to the female gender, ranging from 27 to 63 years of age, so it corresponds to people who are in the adult age group.

Anthropometric variables were contrasted with the Body Mass Index (BMI) for adults between 18 and 75 years of age, to determine the type of nutritional intervention accompanied by physical activity required by the participants, shown below:

Table 4 assessment and diagnosis of the needs of the participants

#	IMC	NUTRITIONAL	DIET	PHYSICAL
1	56,218	Morbid obesity	Hypocaloric	Requires
2	53,078	Morbid obesity	Hypocaloric	Requires
3	54,786	Morbid obesity	Hypocaloric	Requires
4	57,091	Morbid obesity	Hypocaloric	Requires
5	54,073	Morbid obesity	Hypocaloric	Requires
6	49,510	Morbid obesity	Hypocaloric	Requires
7	49,853	Morbid obesity	Hypocaloric	Requires
8	44,503	Morbid obesity	Hypocaloric	Requires
9	40,213	Morbid obesity	Hypocaloric	Requires
10	60,490	Morbid obesity	Hypocaloric	Requires
11	45,338	Morbid obesity	Hypocaloric	Requires
12	59,050	Morbid obesity	Hypocaloric	Requires
13	37,161	Morbid obesity	Hypocaloric	Requires
14	42,333	Morbid obesity	Hypocaloric	Requires
15	67,730	Morbid obesity	Hypocaloric	Requires

Source: Diagnosis made from BMI in contrast to the heights and weights obtained from the participants of the Cleotilde Guerrero Foundation

100% have type III obesity or morbid obesity because their BMI > 40.21. Therefore, they present problems with type II diabetes, cardiovascular problems, high blood pressure, joint pain and metabolic syndromes. Therefore, the information found made it possible to establish a timeline that will later be used to compare the results once the intervention of the purple cabbage-based diet has been applied. Subsequently, the second evaluation was carried

out considering the same aspects, schedule and conditions similar to the previous one, on September 29, 2023 after the intervention with the diet based on purple cabbage, the values obtained include:

Table 5 Second evaluation of the participants

Partic.	Age	Date of Birth A-MM-DD	Weight (Kg)	Size (Mts)	Waist circumference (cms)
P1	57	1965-07-18	87,70	1,56	105,00
P2	32	1990-01-06	74,84	1,41	92,00
P3	40	1981-12-20	84,37	1,54	103,00
P4	51	1971-07-30	81,64	1,43	104,00
P5	56	1966-08-12	81,65	1,51	96,00
P6	48	1973-12-12	75,75	1,53	92,00
P7	62	1960-05-21	84,75	1,70	104,00
P8	63	1959-07-20	70,76	1,59	85,00
P9	56	1965-11-28	56,70	1,41	86,00
P10	48	1973-10-17	86,50	1,43	110,00
P11	27	1995-06-02	67,10	1,48	79,00
P12	25	1998-05-22	93,89	1,59	96,00
P13	53	1970-11-27	57,60	1,55	105,00
P14	52	1963-04-18	63,50	1,50	81,00
P15	52	1971-04-07	100,24	1,48	112,00

Source: data obtained during the sizing and weighing of the participants of the Cleotilde Guerrero O Foundation, dated September 29, 2023.

Once the intervention is performed with the purple cabbage-based nutritional plan in 4 weeks, they represent significant changes that are shown in weight and abdominal circumference, as shown below:

Table 6 Variation in weight (KG) and abdominal circumference (cm)

	WEIGHT			WAIST CIRCUMFERENCE		
	Initial	Final	Variation (kg)	Initial	Final	Variation (cm)
P1	87,70	82,00	-5,70	108	105	3
P2	74,84	74,00	-0,84	102	92	10
P3	84,37	87,00	2,63	104	103	1
P4	81,64	83,00	1,36	102	104	-2
P5	81,65	81,00	-0,65	98	96	2
P6	75,75	74,00	-1,75	96	92	4
P7	84,75	82,00	-2,75	107	104	3
P8	70,76	69,00	-1,76	88	85	3
P9	56,70	58,00	1,30	94	86	8
P10	86,50	84,00	-2,50	114	110	4
P11	67,10	65,00	-2,10	81	79	2
P12	93,89	85,00	-8,89	105	96	9
P13	57,60	85,00	27,40	108	105	3
P14	63,50	65,00	1,50	88	81	7
P15	100,24	81,00	-19,24	107	112	-5

Source: The data were obtained from the weighing of the participants and processes with the help of the Microsoft Excel tool, using the formula, variation (weight or final perimeter – initial perimeter weight).

Fig. 1 shows the variations obtained in the 15 participants after the intervention of the nutritional plan, which shows a general trend towards a reduction in weight and abdominal circumference of the participants, where a greater decrease in measurements in the abdominal circumference variable is observed.

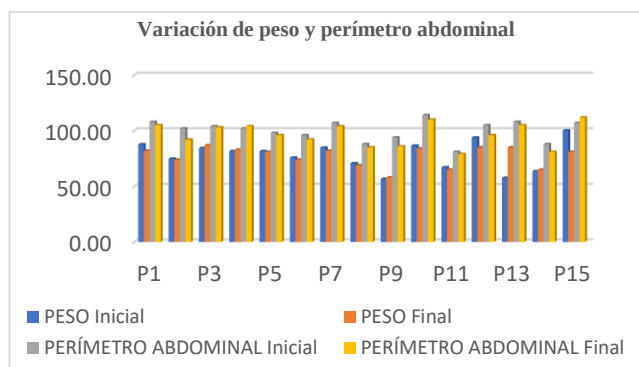


Fig. 1 Weight variations (Kg)

To the same extent, the presentation of the data in this matrix facilitated statistical processing to know the trends at the beginning and after the intervention with the purple cabbage-based diet, based on the weight of the participants according to their sex, as well as the abdominal circumference that shows the changes by comparing the measures obtained and determining the impact of the changes observed in the the participants of the Cleotilde Guerrero Foundation O:

Table 7 statistical analysis of anthropometric variables

	Weight	Perimeter
Media	-0,80	-3,47
Standard Deviation (SD)	9,490946413	3,96
95% confidence interval (CI)	2,450551826	1,022912121
Cohen's	-0,084220614	-0,875040452

Source: data obtained using Microsoft Excel formulas = average (participant weight or perimeter difference 1: participant weight difference or perimeter 15), = DESVEST. M(difference in weight or participant perimeter 1: difference in weight or participant perimeter 15), =DESVEST. M(difference in weight or perimeter participant 1: difference in weight or perimeter participant 15) /ROOT(#PARTICIPANTES)), =MEAN difference in weight or perimeter/STANDARD deviation weight or perimeter.

A reduction in the body weight of the participants of the Cleotilde Guerrero O Foundation was found, with a mean difference of $0.80\text{kg} \pm 9.49$. This decrease shows high variability among participants. The 95% confidence interval (CI) was approximately -3.25 to 1.65 kg, which shows that this change is inconclusive. To the same extent, the effect size calculated through the Cohen's statistic was $d=0.08$, which refers to a very small effect.

On the other hand, the abdominal circumference shows a decrease in the mean from $-3.47\text{ cm} \pm 3.96\text{ cm}$, which shows a tendency to reduce measurements more consistently. The 95% confidence interval (CI) obtained ranges from -4.49 to -2.45 cm, which suggests greater precision in the estimation. While the effect size was $d= -0.88$, which shows a large effect and refers to a relevant impact on the nutritional intervention.

On the other hand, to determine the difference in the evaluated group is real or random, it is pertinent to perform

a Student t-test for related samples, where the following was obtained:

Table 8 t-test for related samples

	Weight		Waist circumference	
Media	77,0921429	76,6428571	99,5714286	96,0714286
Variance	168,223695	84,5549451	85,3406593	113,60989
Observations	14	14	14	14
Pearson's correlation coefficient	0,66134596		#N/A	
Hypothetical difference of the means	0		0	
Degrees of freedom	13		13	
Statistic t	0,17244928		3,18703238	
P(T<=t) a cola	0,43287007		0,00357186	
Critical value of t (one tail)	1,7709334		1,7709334	
P(T<=t) dos colas	0,86574014		0,00714372	
Critical t value (of colas)	2,16036866		2,16036866	

Source: Data obtained using Microsoft Excel, data, t-test for means of two paired samples.

The results obtained in the analysis of descriptive data, specifically the *Student t-test* for related samples, allow us to determine that body weight refers to a value of 0.86. That is, it does not represent a significant difference ($p>0.05$). On the other hand, the abdominal circumference refers to a result of 0.007 that shows a significant reduction, and leads to associate nutritional intervention with the decrease in adipose tissue.

4.- Discussion

The research carried out shows the variations in the anthropometric aspects of the participants after the nutritional intervention based on purple cabbage. Changes related to the variable weight and abdominal circumference were observed, which refer to significant indicators in the assessment carried out to achieve weight reduction in individuals with obesity. The results could indicate that foods that present bioactive compounds in a food plan proposed by professionals in the area and according to individual needs allow improving the parameters related to excess weight. Some studies suggest that diets where vegetables that have antioxidant compounds and fiber are used generate a loss of body weight due to the satiety that it causes and contributes to accelerating metabolism. [25][26]

The results are aligned with the fulfillment of the proposed objective, which includes analyzing the effectiveness of the purple cabbage-based slimming diet at the Cleotilde Guerrero O Foundation. So, the vegetable with a purple hue can contribute to weight loss, due to its high content of antioxidants, such as anthocyanins and flavonoids, which have beneficial effects on metabolism and fat burning. In addition, its high dietary fiber content can promote satiety and reduce total caloric intake. The consumption of this food is recommended to reduce obesity and overweight. In

addition, prevent diseases derived from excess body fat. [27][28] [29]

The findings are consistent with previous research that could indicate that the consumption of vegetables as a functional food proposal based on natural products can be considered in the hypocaloric diet to reduce adiposity in the body and in recent years has been part of the strategies of nutrition specialists to prevent chronic diseases. In particular, the bioactive compounds that emerge from the Brassica family affect the physiological process and control the weight of individuals. [30]

The descriptive statistical analysis leads to identify the behavior of the anthropometric variables that were assessed in the participants with the measurements made for their effect, the processing of the information through Microsoft Excel was considered and the calculation of the central trends and dispersions that refer to: the mean, standard deviation, minimum and maximum values of aspects such as body weight, height and abdominal circumference. The results show high values of body mass index in all participants, which are higher than 40 kg/m², which suggests a type 3 obesity work, according to the criteria indicated by *la World Health Organization* it is also considered morbidly obese. When cases of severe obesity were found in those attending the Cleotilde Guerrero O Foundation, the need to consider the application of a nutritional intervention aimed at weight reduction and control was highlighted. Consequently, the descriptive analysis shows a positive impact due to the dietary intervention based on Purple Cabbage. [31]

The analysis is comparative of the results obtained, suggesting that the consumption of vegetables that present phenolic compounds can contribute to the reduction of the indicators associated with obesity, which due to oxidative stress has generated a prominent adipose tissue. Although most of the studies carried out have been carried out in generalized settings, there is limited evidence that supports the feasibility of dietary interventions in a specific population. [32]

Therefore, the findings support the premise about the health benefits, due to weight loss, consuming purple cabbage may provide additional health benefits, such as reducing the risk of cardiovascular disease and improving digestive health due to its antioxidant and fiber content. To the same extent, it causes better self-esteem and minimizes depressive traits. [33]

Long-term sustainability, it is important to note that, although this study shows promising results, further research needs to be strengthened to determine the long-term sustainability of purple cabbage-based slimming diets. Adherence to this type of diet over time and its long-term effects can significantly reduce obesity and overweight statistics globally.

On the other hand, other aspects that were considered to achieve a favorable impact on weight loss were personalization and supervision, is vitally relevant, although purple cabbage can be beneficial in weight loss, it is crucial to keep in mind the importance of diet personalization and medical supervision. Nutritional needs can vary between individuals, and it is essential to adapt slimming diets according to the specific characteristics and requirements of each person. [34] [35]

The study allowed an analysis of the impact of purple cabbage-based diets to be carried out on a group of participants from the Cleotilde Guerrero O Foundation, where anthropometric variables such as body weight, body mass index height and abdominal circumference were considered. Thus, through the analysis of the data collected in the intervention period, it was identified that some indicators present problems, specifically weight and abdominal circumference. Factors that supported the integration of nutritious foods in a meal plan that allows weight control in people who are obese.

In addition, the nutritional plan was accompanied by the recommendation to perform physical activity of approximately 30 minutes a day, for example, walking, running, climbing stairs which are basic exercises recommended for people who are in the intervened age group, the same who access a caloric expenditure between 120 – 200 kcal per session performed. However, a detailed or quantified control of compliance with this suggested parameter was not carried out. Therefore, it is not possible to specify the influence of physical activities on the results obtained. Therefore, this may have acted as a confounding variable influencing weight reduction.

The results are aligned with the objective of the study aimed at evaluating the benefits of purple cabbage as a nutritional strategy to reduce measures. However, the data obtained are not generalizable to the entire population because they constitute exploratory evidence in a community context. The research carried out allows to minimize the gap in the literature by carrying out an analysis of the application of a diet based on purple cabbage considering a specific and real context to implement an innovative and low-cost nutritional proposal. From the perspective of chemical engineering applied to gastronomy, the research accesses the interpretation of the chemical composition of food and associating it with the impact of consumption on human health. Thus, the presence of active compounds in plants corresponds to a necessary and relevant line of research for the design of food strategies that are aimed at improving the quality of life of individuals regardless of their age. [36]

It is pertinent to recognize that the limitations for the development of the study must be considered in order to interpret the data obtained. In other words, the intervention carried out corresponds to a short period of implementation and assessment, which affects the evaluation of the long-

term effects and the determination of the benefits of the diet in relation to health indicators. In addition, the daily eating habits, physical activity index and other characteristics presented by the participants can affect the response to the nutritional intervention carried out and generate changes in the results. In addition, the daily eating habits, the physical activity index and other characteristics presented by the participants can affect the response to the nutritional intervention carried out and generate changes in the results observed. [37] [38]

In future research, a greater number of variable participants and periods should be considered to monitor and determine long-term changes. The results found reinforce the idea of the importance of promoting the consumption of natural foods that present bioactive compounds, as a strategy to encourage a balanced and healthy diet. In such a way, the information obtained from nutrition, gastronomy, chemical engineering allows the generation of innovative proposals based on scientific evidence [39]

By addressing the level of adherence and compliance with the diet by the participants. The effects on health and weight loss, which is important to establish the possible effects of purple cabbage-based slimming diets on the general health of the participants in which improvements in health markers such as blood glucose levels, blood lipids or blood pressure were observed. The results reported adverse effects associated with the consumption of purple cabbage.

It should be noted that the results obtained are not generalizable to the entire adult or elderly population with obesity 3 or morbid, since the sample size is small and was selected for convenience. However, the information presented shows important data in a community context where it is not frequently explored. Therefore, it can be classified as exploratory because it leads to the identification of the changes that can be associated with the implementation of a nutritional plan based on purple cabbage. So that it can serve as a basis for new research with a more representative design to verify the findings obtained.

5.- Conclusion.

The study provides scientific support for the relevance of natural foods that have functional properties in the context of nutrition. The colorada, due to its high level of nutrients, bioactive compounds and dietary fiber, is a vegetable with the potential to be implemented in healthy eating programs aimed at any sector of the population that has problems of overweight or obesity. By virtue of what has been found, it can be specified that research contributes significantly to expanding knowledge about food use. In nutritional interventions.

The link that exists by integrating nutrition, gastronomy, chemical engineering for the analysis of food and the benefits in human health, which allows structuring food strategies that improve the quality of life of the population.

From a practical point of view, the results collected show that purple cabbage is a vegetable that can be implemented in a nutritional intervention program not only for people with obesity but also for those who have weight control problems to minimize the existence of diseases in the future. However, it is important to note that slimming diets must be designed based on a personalized diagnosis where there is enough information to determine if the consumption of daily food is adequate considering factors such as age, health and metabolic characteristics.

Finally, it is recommended that in future research the study population be expanded, as well as the intervention periods and even integrate other variables that allow a more accurate evaluation, for example, considering biochemical and metabolic indicators that serve as a complement to the anthropometric evaluation and allow optimizing the implementation of balanced eating strategies.

6.- Contributions of the authors (Taxonomy of roles of collaborators - Credit)

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