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Original Article

Differences in the Effects of Red and White Dragon Fruit Extracts (Hylocereus Polyrhizus and Undatus) on the Body Weight of Mice with Obesity

Yenny Erika[1], Djulim[1*], Johanna Fransiska Wijaya[1], Olivia Des Vinca Albahana Napitupulu[1]

[1]Department of Biomedicine, University of Prima Indonesia, Medan, Indonesia

(Correspondence author's email, djulim99@gmail.com)

ABSTRACT

Obesity causes many severe diseases. Thus, prevention efforts must include regulating body weight, increasing physical condition, or using natural goods like plant medicine in pure compounds with antioxidants. This study examined whether red and white dragon fruit extracts (Hylocereus polyrhizus and undatus) reduced body weight in obese Wistar rats (Rattus norvegicus). This type of research is quantitative, with true experiments. The samples used were 24 Wistar mice. The research treatment groups were negative control, positive control, group 3 with Red Dragon Fruit Extract 100 mg/BW/day, and group 4 with White Dragon Fruit Extract 130 mg/BW/day. The research procedures started with the acclimatization of test animals, phytochemical processes, increasing the body weight of mice, monitoring body weight, and testing leptin and FFA levels. The research data was processed using SPSS. This study found that extracts from red and white dragon fruit extracts reduced FFA better and substantially impacted leptin levels (p = 0.010). The normality and homogeneity tests showed significance > 0.05 in each group pre-and post-test. The pre-test data probability was 0.369, and the post-test probability was 0.164 > 0.05. One-way ANOVA test results: pre-test data 0.325 > 0.05, 0.000 < 0.05. Red Dragon Fruit Extract at 100 mg/BW/day and White Dragon Fruit Extract at 130 mg/BW/day helped the treatment group lose weight, while the control group remained obese Wistar rats. The research conclusion shows that red and white dragon fruit contains tannins, flavonoids, alkaloids, steroids, terpenoids, and saponins, which can help reduce the weight of obese Wistar rats.

Keywords: *Obesity, White Dragon Fruit Extracts, Red Dragon Fruit Extracts, Free Fatty Acid*

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INTRODUCTION

Over the past 40 years, obesity has become a global health issue [1,2]. This is caused by unhealthy bodily fat accumulation [3]. Detecting obesity can use BMI, a simple indicator of body weight for height, to define adult overweight and obesity. A person's weight in kilograms divided by their height in meters squared is kg/m^2. The WHO defines obesity as a BMI ≥30 kg/m^2, whereas overweight is a BMI ≥25 kg/m^2 [4].

Lifestyle factors like diet and exercise, hereditary factors like parental obesity, underlying medical conditions, and medication use, and demographic factors like age, gender, place of residence, education level, and income can promote overweight and obesity [5]. Lifestyle considerations are essential since environmental variables, including high-calorie foods, sugary drinks, lack of exercise, and TV, drive worldwide obesity [6]. Modern lifestyles promote obesity by encouraging overeating and under-exercising [5, 6]. Adult television viewing has been linked to obesity in certain studies [7].

Humans get all their energy from food and drink, store it as high-energy molecules, and use it for essential metabolic function,

activity, and thermogenesis [8, 9, 10]. Typically, the body's energy input equals its output. However, 60–80% of energy surplus is stored as fat when consumption exceeds expenditure [11]. An energy imbalance between calories burned and consumed causes obesity. Food and liquids provide energy, while physical exercise, breathing, digestion, and body temperature control burn it [12]. Consuming more calories than the body burns leads to overweight and obesity. They were stored as bodily fat [13].

Obesity has increased worldwide due to high-fat, high-sugar, and oversized meals that contribute to overeating and a lack of exercise. Other dietary modifications include reducing complex carbs, fiber, and fruit and vegetables [5]. Urbanization helps individuals use technology, vehicles, and other mechanical aids, reducing physical exercise. Urbanization offers cheaper, higher-calorie food with energy density, contributing to weight gain [12, 14].

One cause of abnormal serum lipoprotein levels is obesity. Obese people have elevated TG, VLDL, Apo B, and non-HDL-C [15]. Increased body weight causes more lipid problems. Since lipids are insoluble in water, cholesterol and triglycerides must be carried into the bloodstream with lipoproteins. Lipoproteins transport dietary lipids from the small intestine to the liver, muscle, and adipose tissue, hepatic lipids to peripheral tissues, and reverse cholesterol transport from peripheral tissues to the liver and intestine [15,16,17]. Endothelial Lipoprotein Lipase (LPL) hydrolyses Free Fatty Acid (FFA) in obese people due to fat build-up. FFA build-up causes high triglyceride levels because FFA molecules combine glycerol to form triglycerides [18,19]. Obesity raises plasma FFA levels because more extensive adipose tissue releases more FFA [20,21].

Obesity increases the risk of fatal diseases. Type 2 diabetes, cardiovascular disease, metabolic syndrome, chronic renal disease, hyperlipidemia, hypertension, NAFLD, some cancers, obstructive sleep apnea, osteoarthritis, and depression are examples [12, 20,21].

Plant or fruit extract can cure obesity as an alternative to standard methods. Dragon fruit, also known as Pitaya or Pitahaya, grows on epiphytic cactus species, including climbing vines from the genera *Hylocereus* and *Selenicereus* in the Cactaceae family and Cactoideae subfamily. Betalains, hydroxycinnamates, flavonoids, fiber, and vitamin C are abundant in dragon fruit [22].

Different countries grow different dragon fruit varieties. All have rough skin and sparse leaves. *Hylocereus undatus, polyrhizus*, and *megalanthu*s are the first. The most widely cultivated and sold dragon fruit species are *Hylocereus undatus* (White Flesh) and *Hylocereus polyrhizus* (Red). Secondary metabolites, beneficial chemicals, can be isolated from all dragon fruit components. The meat and skin of dragon fruit are rich in phytochemicals and can be utilized as herbal medicine or natural dye [22, 23].

Following the premise, the current study intends to ascertain whether obese Wistar rats (Rattus norvegicus) can be successfully weight-reduced by providing red dragon fruit extract (*Hylocereus polyrhizus*) and white dragon fruit extract (*Hylocereus undatus*).

METHOD

An actual or laboratory experimental design is used for an experimental quantitative research model [24]. This pre-test–post-test control group study examined how red and white dragon fruit extracts reduced obesity in Wistar rats. This study employed Wistar white rats (*Rattus norvegicus*), 160-200g, 2-3 months old, healthy, with no anatomical abnormalities, and never previously used as samples. Exclusion criteria were mice that died or were disabled throughout the trial [25].

The method and measuring tools used for red and white Dragon Fruit Extracts use ethanol solvent, and calculating the dose of the extract and applying it is done with the help of a blunt sonde. Methods for determining obese mice using the Lee Index. Method for determining obese mice with the Lee Index. The tool was used to measure the weight of mice with a digital scale. Leptin examination using the Enzyme-Linked Immunosorbent Assay (ELISA) method with the Euroimmun Analyzer-I instrument with standardized reagents. I also checked FFA levels using the half-micro test method and enzymatic colorimetric assay.

Sample computations were made using the Ferderer formula $(n-1)\times(t-1)\geq 15$, yielding $n \geq 6$ mice [26]. According to calculations, six mice were needed for testing. These experiments employed 26 mice per group. For 14 days, test animals were randomly assigned to four treatment test groups: Negative Control Group,

Positive Control Group, Group 3 with Feed + Red Dragon Fruit Extract at 100 mg/BW/day, and Group 4 with Feed + White Dragon Fruit Extract at 130 mg/BW/day. The groups that received placebo or inert substances were Group 3 (red dragon fruit extract) and Group 4 (white dragon fruit). This study only looked at changes that occurred due to treatment with dragon fruit extract and did not examine other potential confounding variables such as diet, level of physical activity, or environmental factors.

Red dragon fruit (*Hylocecarus polyrhizus*) and white dragon fruit (*Hylocecarus undatus)* extracts are the independent variable, weight loss in mice, leptin levels, and FFA levels are the dependent variable, and high diet fat is the precondition.

Spectrophotometer, rat cage, Ohauss scale, blender, stirrer, pen, paper, rotary evaporator, porcelain cup, test tube, stopwatch, 3 ml syringe, gloves, mask, blunt-tipped syringe, Experimental animal food and drink, red and white dragon fruit, quail eggs, rat pellets, alcohol, distilled water, and 90% ethanol are used.

Obese mice fed a high-fat diet were measured using the Lee index method with the provision that mice were considered obese if the Lee index was > 0.300 [27]. Mouse body weight was measured using digital scales, leptin was tested using the Euroimmun Analyzer instrument with standardized reagents, and FFA levels were tested using the half micro test method, enzymatic colorimetric assay.

The Animal House, Faculty of Mathematics and Natural Sciences, University of North Sumatra, acclimated test animals for seven days to start the investigation. Create red and white Dragon Fruit Extract. Check the fruit extract for tannins, flavonoids, alkaloids, steroids/terpenoids, and saponins with a phytochemical test. They continued Rat Weight-Increasing Preparations for 14 days. A four-group treatment followed. Then, measure the animals' body weight, Leptin, and FFA levels. Test results were processed using SPSS 25.

The data normality test was analyzed using the Kolmogorov-Smirnov test approach ($p > 0.05$). To test the significance between groups, the test was carried out using a one-way analysis of variance technique or One-way ANOVA at a confidence level of 95% ($p < 0.05$)[28]. Further analysis or testing was carried out using the Post Hoc Test with the LSD technique.

RESULTS

The treatment process for the 24 test animals began by giving the mice a preconditioning treatment with a high-cholesterol diet in the form of quail egg yolks, which were given exogenously for 14 days to induce obesity. The following are the characteristics of research test animals:

Table 1. Characteristics of Test Animal

Component	Treatment Group			
	P1	P2	P3	P4
Types of Rats	Rattus norvegicus			
Gender	Male			
General Condition	White fur, healthy and active			
Avg Initial BW	256	255	256	255
Avg Final BW	241	208	202	195

The mice were given a high-fat meal of quail egg yolks daily. This meal artificially increases the mice's body weight—a 14-day regimen of high-fat, high-cholesterol meals.

Table 2 shows test animal treatment results. Before treatment, male white Wistar rats in the negative control group (P1) had an average body weight of 255 ± 1.47 grams. Providing regular feeding and distilled water reduced the average body weight of male Wistar white rats to 240 ± 4.05 grams. After treatment, male white Wistar rats in the positive control group (P2) lost weight. Before treatment, it was 254 ± 0.98 grams. Regular meal treatment with swimming and distilled water reduced male white Wistar rats' body weight to 210 ± 1.94 grams. In treatment group 3, the average body weight of male white Wistar rats dropped before and after red dragon fruit extract therapy. Before treatment, it was 255 ± 1.48 grams. The average body weight of male white Wistar rats reduced to 200 ± 2.67 grams after receiving regular meals and red dragon fruit extract. The average body weight of male white Wistar rats in treatment group 3 decreased the most after receiving white dragon fruit extract. Before therapy, it was 255 ± 2.33 grams. The average body weight of male white Wistar rats reduced to 177 ± 2.66 grams after receiving a regular meal and white dragon fruit extract.

Table 2. **Body weight of mice per group**

Repetition		Treatment Group Body Weight (Gram)			
		P1	P2	P3	P4
1st	Pre	256	255	257	258
	Post	239	210	197	173
2nd	Pre	257	255	256	256
	Post	244	209	198	180
3rd	Pre	253	253	253	252
	Post	243	209	202	180
4th	Pre	254	254	254	253
	Post	245	213	200	178
5th	Pre	255	253	256	257
	Post	241	208	204	176
6th	Pre	256	255	255	256
	Post	240	212	202	177
AVG	Pre	255	254	255	255
	Post	240	210	200	177
SD	Pre	1.47	0.98	1.48	2.33
	Post	4.05	1.94	2.67	2.66

Table 3 shows that negative control mice lost 255 to 240 grams. The positive control group weight dropped from 254 to 210 grams. Treatment group 1 received rat pellet feed + red dragon fruit extract at 100 mg/BW/day, decreasing from 255 to 200 grams. Treatment group 2 received rat pellet feed + White Dragon Fruit Extract at 130 mg/BW/day. Day saw the highest drop, from 255 to 177 grams. These data show that treatment group 2, which received rat pellets + White Dragon Fruit Extract at 130 mg/BW/day, lost the most and the least weight in the negative control group. The Lee index value for each group shows if the mice are still fat.

Control mice treated with distilled water were still fat or had Lee index values > 0.3 [27]. Treatment group 1 received 100 mg/BW/day rat pellet feed + red dragon fruit extract and saw a Lee index fall from 0.32 to 0.26. Rat pellets and 130 mg/BW/day of White Dragon Fruit Extract were given to treatment group 2. Lee's index dropped from 0.31 to 0.24. Based on this data, the control group lost a little weight but remained obese, while the treatment group received rat pellets + Red Dragon Fruit Extract at 100 mg/BW/day and White Dragon Fruit Extract at 130 mg/BW/day. Lost weight and stopped being fat.

Table 3. Body Weight Treatment Result

Parameter	Groups	After Average Weight	
		High Fat Diet	Being given treatment
Body Weight (Gr)	P1	255	240
	P2	254	210
	P3	255	200
	P4	255	177
Naso-anal Length (mm)	P1	198	199
	P2	199	213
	P3	189	216
	P4	190	218
Lee index	P1	0.33	0.30
	P2	0.33	0.27
	P3	0.32	0.26
	P4	0.31	0.24

Table 4. Mean Leptin Levels

Groups	Number of Samples	Leptin Levels (Mean ± SE) (ng/ml)
P1	6	8,5 ± 1,37
P2	6	12,35 ± 0,98
P3	6	10,85 ± 0,86
P4	6	10,33 ± 0,69

The Rat LEP (Leptin) ELISA Kit (Catalog No.: E-EL-R0582) is available from Elabscience Biotecnology and can measure leptin levels. The test was conducted by the instructions provided in the kit. Table 4 shows the average leptin levels for each treatment group.

The typical ranges for leptin levels are: The range for those designated female at birth is 0.5 to 15.2 ng/mL. Subjects identified as male at birth: 0.5 - 12.5 ng/mL [29]. Table 4 reveals that the positive control group (P2) had higher leptin levels without extract. After giving Red Dragon Fruit extract at 100 mg/BW (P3) and White Dragon Fruit Extract at 130 mg/BW/day (P4), leptin levels changed significantly (p=0.17). Dragon fruit water extract further lowered leptin levels in the treatment group. The Negative Control Group (P1) differed from the Positive Control Group (P2) (p = 0.39), the P3 Treatment Group (p=0.51), and the Treatment 4 Group (p=0.69). Positive Control (P2) shows significant differences between Treatment Groups 3 (p=0.12) and 4 (p=0.29). Thus, Wistar rats' leptin levels are significantly affected by red and white dragon fruit extracts (p = 0.010).

In contrast to triglycerides, which bind fatty acids to one another, free fatty acids (FFA) do not. The hydrolysis and oxidation reactions yield FFA. The free fatty acid analysis outcomes regarding storage time are available in Table 5.

Table 5. Free Fatty Acid (FFA) Research Results

Day-to-day storage	P3 Treatment	P4 Treatment
2	0.059	0.045
4	0.059	0.050
6	0.059	0.055
8	0.061	0.056
10	0.059	0.040
12	0.058	0.035
14	0.065	0.042

Note: P3 Treatment: Red Dragon Fruit Extract at a dose of 100mg/BW/day, P4 Treatment: White Dragon Fruit Extract at a dose of 130 mg/BW/day

Table 5 shows that the sizeable adsorbent dose lowers FFA levels. The higher the adsorbent dosage, the more FFA is decreased. Table 5 demonstrates that the original sample had 0.065% FFA, but FFA decreased as the adsorbent weight increased. The lowest FFA value was 0.294% with 100 mg/BW red dragon fruit after 1 hour of stirring. The most significant FFA decrease was 57.06% with a 30:70 husk-fiber mixture and 20% adsorbent dosage. However, 70:30 adsorbents only reduce FFA by 55.2%. The study found that extracts from red and white dragon fruits were more efficient at lowering FFA levels. The free fatty acid value increased little, but from day 8 to day 14, it climbed by 0.08%. Hydrolysis increases free fatty acid value. FFA generation increases with storage time because triglyceride hydrolysis forms water on the side walls of plastic containers.

According to the phytochemical tests, white and red dragon fruit extracts contained secondary metabolite chemicals such as triterpenoids, flavonoids, saponins, and tannins. The Wistar strain of white rats, which are prone to obesity, show signs of weight loss when given these chemicals.

Using these data, the Kolmogorov-Smirnov test was kept as a normal test. To ensure that these results were normal, the Kolmogorov-Smirnov test was maintained. A p-value greater than 0.05 indicates that the data follows a normally distributed distribution, whereas a p-value lower than 0.05 indicates that the data does not[28].

Table 6. Normality Test Result

Groups Treatrment		Kolmogorov-Smirnov	
		N	Sig.
Pre-Test	P1	6	.200*
	P2	6	.200*
	P3	6	.256
	P4	6	.200*
Post -Test	P1	6	.200*
	P2	6	.256
	P3	6	.200*
	P4	6	.200*

*. This is a lower bound of the true significance.
a. Lilliefors Significance Correction

If the p-value exceeds 0.05, the data is considered to have a normal distribution according to the normality test. The pre-and post-test findings from the Kolmogorov-Smirnov test demonstrated significance levels greater than 0.05 across all groups.

Table 7. Homogeneity Test Results

	Levene static	df1	df2	Sig
Pre-test	1.463	3	20	.369
Post-test	1.952	3		.164

Table 7 displays the outcomes of the homogeneity test, which was conducted using the Levene test. In the significance column, the probability value of the pre-test data is 0.369, and the post-test data has a significance value of 0.164. Because the calculated significance probability is more significant than 0.05, we can say that the populations of the negative control group (P1), positive control group (P2), treatment group 3 (P3), and treatment group 4 (P4) are either completely homogeneous or share the same variance. This allows us to move on to the one-way ANOVA test.

Table 8 shows that the pre-test data gave a significance value of 0.325, more significant than 0.05, according to the One-Way ANOVA test. So, there is no discernible change from the pre-test data. Nevertheless, The post-test data found a significant 0.000 or less than 0.05. These results show that the post-test scores of the treatment group differ significantly from those of the control group.

Table 8. One-Way ANOVA Test Results

Groups	Sum	df	Mean	F	Sig
Pre-Test					
Between	15.00	3	3.543	1.987	.325
In	39.00	20	2.685		
Total	58.00	23			
Post-Test					
Between	9850.00	3	3283.3	324.3	.000
In	162.00	16			
Total	10012.00	19			

Table 9. LSD Post-Hoc Test Results

Groups		Mean difference	Sig
P1	Tratment 2	31.000*	.000
	Tratment 3	39.000*	.000
	Tratment 4	62.000*	.000
P2	Tratment 1	-31.000*	.000
	Tratment 3	8.000*	.001
	Tratment 4	31.000*	.000
P3	Tratment 1	-39.000*	.000
	Tratment 2	-8.000*	.001
	Tratment 4	23.000*	.000
P4	Tratment 1	-62.000*	.000
	Tratment 2	-31.000*	.000
	Tratment 3	-23.000*	.000

To find out if there are substantial changes between groups, the LSD Post Hoc Test is utilized. In this study, the Post Hoc LSD test analysis revealed that there were significant differences between the control and treatment groups, with significance values of 0.000 and 0.001, respectively, which is smaller than 0.05.

DISCUSSION

This study aimed to compare the efficacy of red and white dragon fruit extract in lowering body weight in obese male Wistar rats at different doses to that of distilled water in a pre-test-post-test control group design.

Before being administered a mixture of red and white dragon fruit extract and distilled water, the typical weight of the mice was 255 grams. All groups showed a reduction in body weight, but the fourth treatment group, which received 130 grams of white dragon fruit extract, had the most dramatic effect. Mg/BW saw the most significant weight reduction.

The negative control group (P1) mice lost 255 to 240 grams. The positive control group (P2) lost 254 grams to 210 grams. Treatment group 3 (P3), given rat pellet feed + red dragon fruit extract at 100 mg/BW/day, also decreased from 255 to 200 grams, and treatment group 4 (P4), given 130 mg/BW/day, decreased the most, from 255 to 177 grams. Treatment group 4 (P4), which received rat pellets + White Dragon Fruit Extract at 130 mg/BW/day, lost the most weight, while the negative control group (P1) lost the least.

The control group, mice treated with distilled water, were still fat or had Lee index values > 0.3. Group 3 (P3) received rat pellet feed + red dragon fruit extract at 100 mg/BW/day and saw a Lee index decrease from 0.32 to 0.26. Treatment group 4 (P4) received rat pellets + White Dragon Fruit Extract at 130 mg/BW/day and saw a Lee index fall from 0.31 to 0.24. Based on this data, the control group lost a little weight but remained obese, while the treatment group that received rat pellets + Red Dragon Fruit Extract at 100 mg/BW/day and White Dragon Fruit Extract at 130 mg/BW/day lost weight and became no longer obese.

The 14-day observation approach yielded data that needed processing and testing, requiring various data analyses. First, data is processed and normality tested. The Kolmogorov-Smirnov test in SPSS determined normality. Pre- and post-test data for all test groups was regularly distributed. Thus, the data is regularly distributed or represents the population.

Levene test examines if normally distributed data comes from a same-variance population. The post-test significance value is 0.164, while the pre-test is 0.369. The significance probability value is more than 0.05; therefore, the pre-test and post-test data for the negative control group, positive control group, treatment group 3, and treatment group 3 are homogeneous. One-way ANOVA evaluated this normally distributed and homogeneous data for efficacy and significance. One-way ANOVA has a significance value < 0.05. A post-hoc LSD test is needed due to significant differences between the control and treatment groups. The group's average body weights were compared using a post-hoc LSD test. This study's Post Hoc LSD test showed that all groups differed with significant values of 0.000 and 0.001 or less than 0.05.

Overall, participants in all groups lost weight, according to the results of this study. In contrast to distilled water and 100 mg/BW of white dragon fruit extract, 130 mg/BW of white dragon fruit extract was more effective in lowering body weight in obese male Wistar rats (Rattus norvegicus). The anti-obesity tannins, saponins, steroids, and flavonoids found in

white and red dragon fruit extracts make this possible [23,30]. Tannins have physiological benefits that help obese mice lose weight, including lowering blood pressure and serum cholesterol levels and displaying strong antioxidant capability [31, 32].

Evidence shows that saponin can aid in weight loss and normalizing serum lipid levels. Flavonoids are potent antioxidants that help ward off harmful free radicals and have anticancer effects, among other medical uses [31,32]. Because of their anti-inflammatory properties, triterpenoids have found therapeutic usage in numerous Asian countries. According to these results, obese male Wistar white rats (Rattus norvegicus) can lose weight with the help of red and white dragon fruit extract.

CONCLUSION

Research has shown that red and white dragon fruit extracts can help obese male Wistar white rats (Rattus norvegicus) lose weight. The fact that the One-Way ANOVA test yielded a significance level of 0.000, which is lower than 0.05, proves this. It is clear from these numbers that the treatment group differs significantly from the control group. All groups were significantly different from one another, according to the Post Hoc LSD test findings, which were either 0.000 or 0.001 or less than the significance level of 0.05.

A 130 mg/BW dose of red dragon fruit extract is more efficient than a 100 mg/BW dose in lowering the weight of obese male Wistar white rats (Rattus norvegicus), according to the results of the observations and data analysis that have been conducted. The Lee index value shows that all groups of mice, except for the control group that received only distilled water, experienced a decrease in body weight, moving them out of the obese category.

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Conflicts of Interest

The authors declare no conflict of interest.

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