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Physico-Chemical, Nutritional Evaluation, Haematology of Water and Amaranth Vegetable Leaves

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Abstract

Vegetables are important protective food and highly benefi¬cial for the maintenance of human health and prevention of disease. The purpose of the research was to determine the Physico- chemical, nutritional evaluation, haematology of water and amaranth vegetable leaves. The composition of the Diets were as follows: Basal 50 %, Casein 30 %, Amaranth Vegetable 10 % (1). Basal 50 %, Casein 30 %, Water leave Vegetable 10 % (2), Basal 50 % Casein 30 % Amaranth Vegetable 5 % Water leave Vegetable 5 % (3), Basal 50 % Casein 30% (4) and Basal 100 % (Diet 5). The formulated Dietary were fed to fifty albino rats that were divided into five of ten in each group experimental animals. The results revealed that Bulky Density values was ranged from 0.46 g-1.436, Swelling Capacity was ranged from 24.95-34.76, Water Absorption Capacity was ranged from 1.202- 1.288 and Gelation Capacity was ranged from 12.58-14.45. Biological values were ranged from 59-63.86, NPU was ranged from 1.9-3.5, NPR was ranged from 1, 8-3.3, PRE was ranged from1.6-2.8. Haematology study shows that white blood cell corpuscle ($WBC10^{-3/UL}$) and Red cell corpuscle ($RBC^{-6/UL}$) were respectively high and above the safe limit. In conclusion vegetable meals was a valuable food ingredients. It contains mineral, vitamin and fiber that could be used to improve animal and human health, also can be success¬fully utilized to build up, protect and repair tissue of the body, highly benefi¬cial for the maintenance of human health and prevention of disease.

Keywords: Experimental animals; Water; Amaranth vegetable leaves

Introduction

Vegetables are parts of plants that are consumed by humans or other animals as food. The original meaning of vegetables are refer to all edible plant matter, including the flowers, fruits, stems, leaves, roots, and seeds [1,2]: They contain valuable food ingredients which can be utilized to supplement human to diets. Amaranth leaves are called the powerhouse for many phytonutrients, antioxidants, minerals and vitamins which contribute immensely to human health and their wellness [3]. Amaranth leaves contain only traces of fats without cholesterol hence could be use during weight reduction programs [4]. The leaves and stems contain a good amount of soluble and insoluble dietary fibers. Fresh 100 g of leaf amaranth contains 29% of recommended daily intake (RDI) of iron and 23 calories/100g. Iron, Zinc and Copper are essential trace element found in amaranth that is required by the human body for production of red blood cell (RBC's) [5]. Fresh amaranth leaves are one of the richest sources of vitamin-C of 100 g of fresh leaves carry 43.3 mg or 70% of recommended daily intake (RDI) of this vitamin. Vitamin-C is a powerful water-soluble antioxidant which plays a vital role in wound healing and help fight against viral infections [4]. Amaranth has several vital antioxidant vitamins like vitamin-A of 2917 IU or over 97% of daily recommended levels per 100 g and (Ali et al.2009) [6]. In addition, vitamin-A is essential for maintaining healthy mucosa, skin maintenance, and is essential factor for ocular (eye) health, and flavonoids is present in vegetables which help to protect lung and oral cavity cancers. Amaranth greens have the highest concentrations of vitamin-K of all the edible green-leafy vegetables, 100 g of fresh greens leave will provides 1140 µg or 950 % of daily vitamin-K requirements. Vitamin-K plays a vital role in strengthening the bone mass by promoting osteoblastic activity in the bone cells. Moreover, it also has been established that it is a succor to patients with *Alzheimer's disease* by limiting neuronal damage in the brain. Amaranth greens also contains ample amounts of B-complex vitamins such as folates, vitamin-B_6 (pyridoxine), riboflavin, thiamin (vitamin B-1), and niacin. Folates rich diets help prevent neural tube defects in the newborns. Moreover, its leaves carry more potassium than that of in the spinach. Potassium is an important component of the cell and body fluids that helps regulate heart rate and blood pressure [7,8] Water leave (Talinum triangulare) is another Golding herbaceous plant which is believe to be underrated and undervalued plants in Nigeria [9]. Some culture even regard waterleaf as a nuisance, a stubborn weed that grows all year round, though it flourishes more during the rainy season. Waterleaf vegetable is another herbaceous plant which has so many health benefits. It is known for its peculiar green colour and pink flower which grows as its

bud [10]: Waterleaf is used in making different delicacies in Nigeria and various part of the leaves and stems are consumed as veggies in some parts of the country [11]. Scientific research on waterleaf had shown that it can inhibit proliferation of cancerous cells and shrink tumors. Other studies have been focused on its cerebral-protective potential and it indicates that consumption of waterleaf enhances brain activities and protect brain tissues, good remedy for insomnia- sleeping disorder [12]. Waterleaf is very beneficial could be taken as vegetable, dried herbs, juice and infusion and. Waterleaf juice is a cheaper way of extract vitamins, minerals and liquids from vegetables, it soothe inflammations, infusion of the leaves is taken as a diuretic, also could be used to curing prostate enlargement when the roots are boiled helps to regulate hypertension and diabetes is also good and safe for pregnant women and growing children and could boosts their blood levels [13-15]. Water leaf contains more proteins than cashew nuts, more pectin, food fiber that helps digestion than apples. Waterleaf also have high level of vitamin A B C, essential amino acids, omega 3-fatty acids, resins, iron, calcium, copper, lead, manganese and zinc carotenoids, alpha and beta tocopherols [16].

Materials and Methods

Chemical Procedure for Determination of Vegetables

Bulk Density Determination: 10g of the samples was filled into a 25ml graduated cylinder and packed by gentle tapping of the cylinder on a bench top ten times. The final volume of the samples was recorded and expressed in g/ml [17].

Swelling Capacity Determination: 20g of each formulated diets and control was weighed into a washed, dried and weighed graduated measuring cylinder. The cylinder was tapped on the table for some few minutes; then 80ml of distilled water will be poured into the cylinder. The cylinder was allowed to stand for one hour after which the final volume of the flour was noted. The ratio of the final would be give the swelling capacity on volume basis. The supernatant was then be decanted and the cylinder with its content weighed to obtain the weight of the net sample. The ratio of the final to initial weight of the sample was given the swelling capacity on the weight basis [18].

Determination of Gelation Capacity: Test tubes containing 20 % (w/v) dispersion of each diet was prepared with 5ml of distilled water. The dispersion was heated for 1hr in a boiling water bath, cooled rapidly under water and subsequently at 40 °C for 2hrs. The test tubes was inverted to determine the concentration at which the sample would not slip [18].

Water Absorption Capacity: Determination1g of the sample was mixed with 10ml of distilled water for 5 minutes on a magnetic stirrer. The mixture was centrifuged at 3500rpm for 30minutes and the volume of the supernatant was measured by using 10ml measuring cylinder on each of the sample. The density of water was assumed to be 1g/ml [18].

$$WAC = \frac{(W_1 - W_2)}{W_3} \times 100$$

W_1 = Final Volume
W_2 = Initial Volume
W_3 = weight of sample

Determination of Viscosity: Cold water slurries containing 10% sample solids was heated in a boiling water bath with constant stirring until boiled was continued for three more minutes. They was be cooled to room temperature and their viscosities was measured with NDJ.8S digital viscometer using spindle No 3 at 30rpm [18].

Analytical Methods: Chemical analysis included Protein (nitrogen x 6.25), moisture, fat, crude fibre carbohydrate, and vitamins of the ingredients and formulated diets was determined according to AOAC (2010) [17].

Materials

Animal Experimentation: The method of [19] was adopted. Fifty Wister albino rats of both sexes were obtained from the Faculty of Pharmacy, Obafemi Awolowo University, Ile-Ife, Osun State, Nigeria. The weights and ages of white albino rats were ranged from 60-70 g and were between 3-6 weeks old, respectively. The experimental animals were randomly weighed selected and distributed into five groups of ten animals per group and were housed in a metabolic cage. They were fed on animal feeds for seven days to acclimatize them to the new environment. The experimental animals were placed on the experimental diets for a period of 28 days. Water and food were administered *ad libitum* to the experimental animal. During the period of the experiment, daily feed intake was recorded and the weights of the experimental animals were taken every three days. Seven days to the end of the experiment, the faeces and urine of the experimental animals in the different groups were collected separately. Urine was stored inside a bottle per group containing 6N HCl to preserve it, prior analysis, and the faeces were dried in an oven at 60 °C for 12 hours, cooled, weighed and stored inside a sealed polythene, per group. At the end of the 28 days, the animals were weighed, anaesthetized and sacrificed. Tissue samples including liver, kidney` and plantaris muscles were removed, Nitrogen in the faeces and urine were determined by the micro Kjeldahl method [17,19]. The organs collected from the animal including heart, kidney and liver were fixed immediately in 10 % formyl saline for further experiment such as Nitrogen retention. [19-21].

Bioassay Calculations: The Food efficiency Ratio (FER), Protein Efficiency Ratio (PER), the Net Protein Retention (NPR) and Protein Retention Efficiency (PRE) were calculated using the formula given below:

$$\text{The Food Efficiency Ratio} = \frac{\text{Gain in body weight (g)}}{\text{Food intake (g)}}$$

$$\text{Protein Efficiency Ratio (PER)} = \frac{\text{weight gain of test animal (g)}}{\text{Protein consumed by the test animal (g)}}$$

$$\text{Net Protein Retention (NPR)} = \frac{\text{weight gain of test animal (g)} + \text{Average Weight Loss of Animal}}{\text{Protein consumed by the test animal (g)}}$$

Statistical Analysis

Statistical analysis of the data was carried out using the one-way Analysis of Variance (ANOVA) technique (SPSS 17 for windows) and the differences was separated using Duncan's Multiple Range Test (DMRT) at a level considered to be significant at $p < 0.05$.

Ethical Consideration

Fifty Wister rats were randomly selected for the experiment and approval was obtained from the Animal Ethical Welfare Review Committee of the Obafemi Awolowo University, Ile-Ife, Osun State, Nigeria.

Results

Group	Bulky Density	Swelling Capacity	Water Absorption Capacity	Gelation Capacity
1	0.61g±.01^{c}	24.95±.02^{b}	1.288±00^{b}	13.36±.01^{b}
2	0.59±00^{b}	34.75±00^{e}	1.384±.03^{d}	14.45±.03^{c}
3	0.67g±02^{d}	33.76±.02^{c}	1.376±.02^{c}	14.30±.02^{c}
4	0.461±03^{a}	23.66±.01^{a}	1.202±.00^{a}	12.58±.00^{a}
5	1.436±01^{e}	34.56±00^{d}	1.436±.01^{a}	16.38±.02^{d}

Mean ±SD values of three determinations with different superscript in a column are significantly different ($P < 0.05$); Basal 50 %, Casein 30 %, Amaranth Vegetable 10 % (1). Basal 50 %, Casein 30 %, Water leave Vegetable 10 % (2). Basal 50 % Casein 30 % Amaranth Vegetable 5 % Water leave Vegetable 5 % (3) Basal 50 % Casein 30% (4) and Basal 100 % (5)
Table 1: Levels of pesticide residues detected in vegetables

Group	Kidney(g)	Heart(g)	Liver(g)
1	0.86±.01^{d}	0.40±.04^{c}	4.04±.03^{d}
2	0.90±.02^{e}	0.36±.03^{b}	4.04±.02^{d}
3	0.83±.00^{c}	0.46±.02^{d}	3.80±.04^{b}
4	0.73±.01^{b}	0.40±.01^{c}	2.60±.03^{a}
5	0.70±.00^{a}	0.55±.00^{a}	4.20±.02^{c}

Mean ±SD values of three determinations with different superscript in a column are significantly different ($P < 0.05$); Basal 50 %, Casein 30 %, Amaranth Vegetable 10 % (1). Basal 50 %, Casein 30 %, Water leave Vegetable 10 % (2). Basal 50 % Casein 30 % Amaranth Vegetable 5 % Water leave Vegetable 5 % (3) Basal 50 % Casein 30% (4) and Basal 100 % (5)
Table 2: Internal Organ of the experimental Animals

Group	BV %	NPU%	NPR	PER
1	63.65^{d}	2.8^{b}	2.7^{b}	2.3^{b}
2	63..86^{c}	3.3^{c}	3.2^{c}	2.7^{c}
3	62.68^{b}	3.5^{d}	3.3^{d}	2.8^{d}
4	59^{a}	1.9^{a}	1.8^{a}	1.6^{a}
5	-	-		

Mean ±SD values of three determinations with different superscript in a column are significantly different ($P < 0.05$); Basal 50 %, Casein 30 %, Amaranth Vegetable 10 % (1). Basal 50 %, Casein 30 %, Water leave Vegetable 10 % (2). Basal 50 % Casein 30 % Amaranth Vegetable 5 % Water leave Vegetable 5 % (3) Basal 50 % Casein 30% (4) and Basal 100 % (5)
Table 3: Biological values of the experimental Animals

Group	Kidney mg/g	Liver mg/g	Muscle mg/g
1	84.35±00[d]	84.30±.01[c]	83.32±.02[c]
2	83.56±.01[e]	83.50±.02[e]	83.48±.01[e]
3	83.38±.02[c]	83.36±.02[d]	83.35±.03[d]
4	80.68±.03[b]	80.64±.03[b]	80.66±.02[b]
5	20.70±.02[a]	20.70±.01[a]	20.30±.03[a]

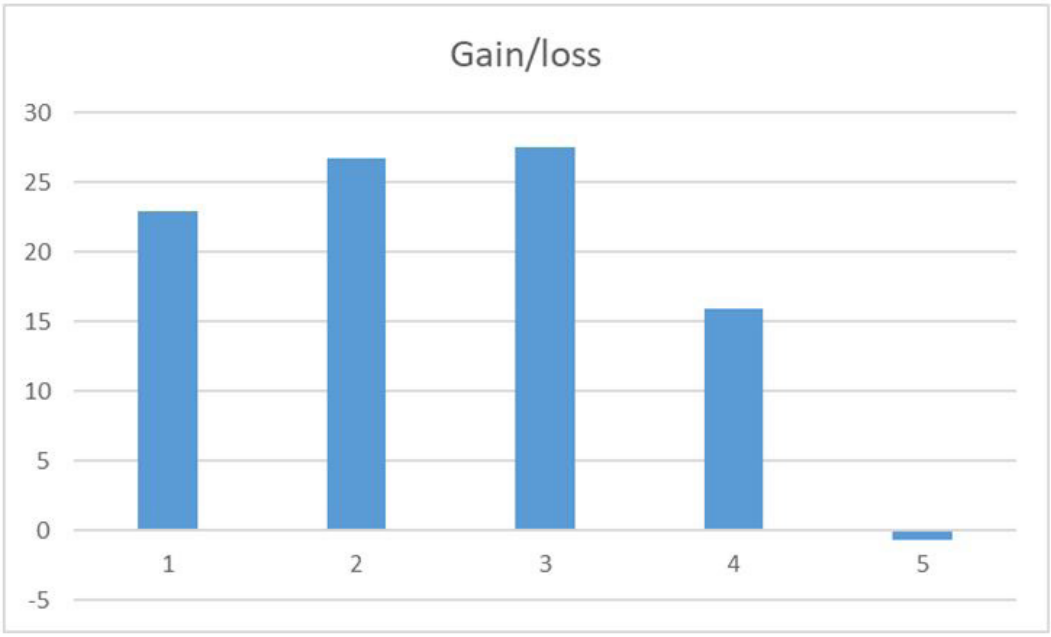
Mean ±SD values of three determinations with different superscript in a column are significantly different (P < 0.05); Basal 50 %, Casein 30 %, Amaranth Vegetable 10 % (1). Basal 50 %, Casein 30 %, Water leave Vegetable 10 % (2). Basal 50 % Casein 30 % Amaranth Vegetable 5 % Water leave Vegetable 5 % (3) Basal 50 % Casein 30% (4) and Basal 100 % (5)
Table 4: The nitrogen retention of the experimental animals

Parameter	1	2	3	4	5	Limits	Alerts
WBC10$^{-3/UL}$	16.4[e]	9.3[b]	12.6[d]	7.3[a]	10.9[c]	2.5-10.5	H
LYM%	63.5[a]	66.9[d]	66.9[d]	66.4[c]	66.1[b]	20-40	H
MON%	7.7[a]	7.7[a]	9.5[c]	8[b]	10.8[d]	1-15	M
GRAN%	28.8[d]	25.4[c]	24.1[b]	35.5[e]	23.1[a]	50-70	L
LYM#$^{-3/UL}$	9.8[e]	6.2[b]	8.4[d]	4.1[a]	7.2[c]	0.6-4.1	H
MON#$^{-3/UL}$	1.2[c]	0.7[b]	1.2[c]	0.6[a]	1.2[c]	0.1-1.8	M
GRAN#$^{-3/UL}$	4.4[d]	2.4[a]	3.0[c]	2.6[b]	2.6[b]	2.0-7.8	L
RBC$^{-6/UL}$	6.21[b]	7.37[c]	6.22[b]	7.63[d]	6.01[a]	3.50-6.50	H
HGBg/dl	16.1[c]	16.3[c]	14.1[b]	17.3[d]	12.4[a]	11-16	M
HCT%	49.1[c]	52.4[e]	42.6[b]	51.3[d]	37.3[a]	36-48	L
MCVfL	79.1[e]	71[d]	68.5[c]	51.3[a]	62.2[b]	80-99	L
MCHpg	26.9[d]	22.1[b]	22.6[c]	22.6[c]	20.6[a]	26-32	L
MCHC g/dl	32.7[c]	31.1[a]	33[b]	33.7[b]	33.2[b]	32-36	M
RDW-SDfL	42.7[c]	39[b]	37.2[a]	37.2[a]	37.4[a]	37-54	L
RDW-CV%	17.5[c]	17.4[c]	17[b]	17.3[c]	16.5[a]	11.5-14.5	H
PLT10$^{-3/UL}$	277[a]	466[c]	869[e]	321[b]	766[d]	90-400	M
MPVfL	7.9[d]	7.8[d]	7.4[b]	7.1[a]	7.6[c]	7.4-10.4	L
PDW%	9.7[b]	10.5[c]	11[d]	8.2[a]	9.5[b]	10-17	L
PCT%	0.21[a]	0.36[c]	0.63[d]	0.22[b]	0.68[e]	0.10-0.28	M
P.LCR%	6.2[c]	9.7[d]	7.4[e]	0.0[a]	5[b]	13-43	L

Mean ±SD values of three determinations with different superscript in a row are significantly different (P < 0.05); Basal 50 %, Casein 30 %, Amaranth Vegetable 10 % (1). Basal 50 %, Casein 30 %, Water leave Vegetable 10 % (2). Basal 50 % Casein 30 % Amaranth Vegetable 5 % Water leave Vegetable 5 % (3) Basal 50 % Casein 30% (4) and Basal 100 % (5)
Table 5: Shows the Heamatology parameters of the experimental animals

Discussion

Table 1 focuses on Physico- chemical parameter of amaranth and water vegetable leaves. Bulky Densities were ranged from 0.46 g-1.436. In bulk density diet 5 was the highest while diet 1 was the lowest, Researcher had earlier discovered that fermentation reduces the bulk density of food by reducing the viscosity. The bulk density is a reflection of the load the sample can carry if allowed to rest directly on one another. High bulk density is desirable for good packing, because it allows more weight to be packed in a limited volume and allows easy transportation [18]. Swelling Capacity ranged from 24.95-34.76, Water Absorption Capacity ranged from 1.202- 1.288 and Gelation Capacity ranged from 12.58-14.45. Swelling capacity for diet 2 is the highest but diet 4 had the lowest value. There was reduction in swelling power of the fermented diets, this could be as a result of action of enzymatic reaction (amylase) released to breakdown the starch into dextrin-maltose which disallowing swelling after undergoing cooked into gruel [18]. Water absorption capacity for diet 2 was 1.384, is the highest while diet 2 is the lowest. The water absorption capacity gave an indication of the amount of liquid available for gelatinization (There were significant differences in the formulated samples compared to the control, the values ranging between 1.202 – 1.487g/g. This may be due to a result of production of liquid gruel due which breakdown of starch by the enzymes activations, which leads to reduction in water absorption capacity and the release in the water trapped in the gel [18] and Gelation Capacity for diet 5 is 16.38 which is the highest but the lowest is 12.58, because they would require a lot of dilution in an attempt to improve digestibility in relation to volume [17,18].



Mean ±SD values of three determinations with different superscript in a column are significantly different ($P < 0.05$); Basal 50%, Casein 30%, Amaranth Vegetable 10% (1). Basal 50%, Casein 30%, Waterleave Vegetable 10% (2). Basal 50 % Casein 30% Amaranth Vegetable 5% Waterleave Vegetable 5% (3) Basal 50% Casein 30% (4) and Basal 100% (Diet 5)

Figure 1: Depict the bar chart of the experiment animal gain and loss

Figure 1 Depicts the bar chart of the experiment animal gain and loss during twenty eight days chart 1-4 were progressive 15.89-27.48g but diet 5 was regressed by 0.78. When compare diet 5 with other diets 1-4. The biological value of protein of normal maize is accompany with low quality protein. Also earlier reported to be deficient in some essential amino acids such as lysine, tryptophan and threonine and, therefore, needs protein supplementation from legume and animal protein [19-21].

Table 2 cited the internal organ of the experimental animals such as kidneys was ranged from 0.70-.086, hearts was ranged from 0.36-0.55, and livers were ranged between 2.6-4.04g. Comparing protein diets 1-4 to non-protein diets. The biological value of maize non-protein diet and generally cereal is low and not of quality owing to the fact that its protein is deficient in certain essential amino acids such as lysine, tryptophan and threonine and, therefore, needs protein supplements from legume and animal protein [19-21].

Table 3 reported the Biological values of the experimental Animals, biological value ranged from 59-63.86, NPU ranged from 1.9-3.5, NPR ranged from 1, 8-3.3, PER ranged from1.6-2.8 from but all the parameters for basal diets were nil but this is because maize non- protein diet 5 is of quantity but has no quality protein, is also deficient in essential amino acids such as lysine, tryptophan and threonine however could be fortified with legume or animal protein, low protein earlier reported for cereal [19-21].

Table 4 revealed the nitrogen retention of the experimental animals kidney was ranged from 20– 84.3 mg/g, diet 4 is the highest while diet 5 is the lowest, liver ranged was from 20.70-84.30 mg/g the liver for diet 1 is the highest while diet 5 is the lowest and 20.30-83.48 mg/g. also diet 2 has the highest reading while the lowest reading is 5. The biological value of protein of maize which diet 5 composed is low owing to the fact that its protein is deficient in essential amino acids such as lysine, tryptophan, and threonine. Therefore, diet 5 needs protein supplementation from legume and animal protein origin [19-21].

Table 5 Shows the Heamatology parameters of the experimental animals. WBC white blood corpuscle was ranged from 10.9- 16.4 above the limit of 2.5-10.5, LYM ranged from 63.5- 66.9 and above the limit of 20-40, MON was ranged from 7.7-10.8 and was moderate 1-15, GRAM was ranged from 23.1-28.8, it was low 50-70, LYM#$^{-3/UL}$ was ranged from 4.1-9.8 and above the limit of 0.6-9.8, MON#$^{-3/UL}$ was ranged from 2.6-44 and it is low, GRAN#$^{-3/UL}$ was ranged from 0.6-1.2, it is moderate 0.1-1.2, (LTP 2011). However white blood cells are high enough to give human body more immune system, it is also capable of fights infections and diseases. Abnormal white blood cell low levels was linked with a sign of infection, blood cancer, or an immune system disorder [22].

Red Blood Corpuscle (RBC) was ranged from 6.01-7.37 and are above the limit of 3.50-6.50, HGB was ranged from 12.4-16.1 and moderate 11.16 low 36-45, HCT was ranged from 37.3-52.4 body for production of red blood cell (RBC's) and act as a co-factor for the oxidation-reduction enzyme, cytochrome oxidase during the cellular metabolism. It was earlier reported that reduction in red blood corpuscle could result in anemia, blood loss, liver disease, as well as leukemia and lymphomas. MCVfl was ranged from 51.3-71.1 below the limit of 80-99, MCHpg was ranged between 20.6-26.9 and below the limit of 26-32, MCHCg/dl was ranged from 31.3-33.2 and it is moderate at 32-36, RDW^{-SDfL} was ranged from 37.4-42.7 below the limit, RDW-CV was ranged from 16.5-17.5 and above the limit of 11.5-14.5. PLT10$^{-3/UL}$ was ranged from 277-766 moderate 90-40, MPVfL was ranged from 7.1-7.8 below the limit of 7.8-10.4, PDW% was ranged from 8.2-9.7 moderate 0.10-0.28, and P.LCR% was ranged from 0-9.7 below 13-43. It has been confirmed that deficient in MCVfl, MCHpg, MCHC, RDW^{-SDFfL}, RDW-CV, PLT10$^{-3/UL}$ MPVfL and PDW% blood parameters could

lead to severe anaemia, blood loss, infection, many congenial conditions, and coagulation disorders. Hence, it is not advisable to take vegetable alone it could be used to supplement diets [22-24].

Conclusion

Water and amaranth vegetable leaves are important protective food and highly beneficial for the maintenance of health and prevention of diseases. Water and amaranth vegetable leaves are valuable food ingredients which can be utilized to supplement to human diets. They are rich sources of carotenoids, vitamin A, B, C, k, thiamine, riboflavin, niacin, alpha and beta tocopherols. Haematology study shows that white blood cell corpuscle ($WBC10^{-3/UL}$) and Red cell corpuscle ($RBC^{-6/UL}$) are high to boost human blood.

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