Original Research Article

EFFECTS OF AQUEOUS AND ETHANOLIC EXTRACTS OF DANDELION (*TARAXACUM OFFICINALE* F.H. Wigg.) LEAVES AND ROOTS ON SOME HAEMATOLOGICAL PARAMETERS OF NORMAL AND STZ-INDUCED DIABETIC WISTAR ALBINO RATS.

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ABSTRACT

The effects of aqueous and ethanolic extracts of *Taraxacum officinale* F.H. Wigg leaves and roots on some haematological parameters of Streptozotocin (STZ)-induced diabetic Wistar albino rats (*Rattus rattus*) were investigated. The parameters investigated include; packed cell volume (PCV), haemoglobin (Hb) levels and white blood cell (WBC) counts. Exactly 75 wistar albino rats weighing between 100–225 g were used for the study, and a total of four groups were created. Two groups were divided into six sub-groups of five rats each for the leaf and root extracts respectively, with the remaining two groups being the normal control rats (NCR) and diabetic control rats (DCR). The two sub-groups were thus; sub I, comprising of sub-groups 1–4 which were for diabetic test rats (DTR) on 6% and 10% of aqueous and ethanolic extracts of leaves respectively, while sub-group 5 and 6 were normal test rats (NTR) on 10% of both extracts of leaves respectively. Same was also the case for sub II which represents the root extracts. Two days after streptozotocin-induction, the administration of *T. officinale* leaf and root extracts (Aqueous and Ethanolic) commenced and lasted for three weeks. Changes in PCV, haemoglobin levels and WBC counts between the NCR and DCR against normal treated rats (NTR) and diabetic treated rats (DTR) on various doses of the extracts were evaluated using one way Analysis of Variance (ANOVA).

Keywords: *Taraxacum officinale*, Aqueous and Ethanolic extracts, STZ induced Diabetes, Haematological parameters

1.0 INTRODUCTION

The use of indigenous plants in the management of diseases has been a common practice in most developed countries and importantly in developing countries throughout the world. However, few of these plants have received adequate scientific scrutiny. Most researches into medicinal plants help in ascertaining the efficacy of the flora as a potent remedy, extending our frontiers of knowledge concerning their pharmacological activity, active principles, therapeutic value, dosage and administration as well as contraindication and side effects. Medicinal plants are administered to patients either as entire plant or as root, leaf, stem, bark, fruit, seed, juice, flower or as exudates and may be taken in form of an infusion or as a decoction (Omeodu 2006). Traditional healers form the basic core of primary health care delivery in 90% of our rural population in Africa. It is found that 60% of Nigeria's rural population depends on traditional medicine for their health care needs (WHO 1996).

As such World Health Organisation is pursuing a coordinated approach to encourage the official recognition of traditional healers and to encourage Western trained doctors and pharmacists to study the methodology and recipes of traditional healers. China for instance has achieved a great success in blending traditional healing system with modern western medicine to form new Chinese medicine (Omeodu 2006). The Nigerian flora had already and continually made great contribution to the health care of the nation (Omeodu 2006). Infact, indigenous medicinal plants form an important component of the natural wealth of Nigeria.

Taraxacum officinale F.H. Wigg. commonly known as Dandelion (from the French dent-de-lion meaning lion's tooth) is thought to have evolved about thirty million years ago in Eurasia. They have been used by humans as food and as a herb for much of recorded history (Dijk *et al*. 2003).

It is a herbaceous perennial plant of the family Asteraceae (compositae), and two major species, *T. officinale* and *T. enythrospermum*, are found as weed worldwide. Both species are edible in their entirety. Like other members of the Asteraceae family, they have very small flowers which are yellowish to orange yellow in colour collected together into a compositae (flower head). Each single flower in a head is called floret and they number 40 to over 100 per head. They grow generally from unbranched taproots, producing one to more than ten stems that are typically 5–40 cm tall and sometimes up to 70 cm tall. Dandelion leaves are unique as a diuretic, a valuable alkalizer to the body; eaten regularly they assist the body to reduce excess acidity, oxygenate, purify and build blood, cleanse and regenerate cells (Clarke *et al*. 1997).

2.0 MATERIALS AND METHODS

2.1.0 Plant Source and Identification

The plant Dandelion (*Taraxacum officinale*) leaves and roots were sourced from farm lands at Umuzi and Umudim villages in Umudioka Ancient kingdom, Orlu local government area of Imo State and the species was identified and confirmed by Dr. F. N. Mbagwu of the Department of Plant Science and Biotechnology, Imo State University, Owerri, Imo State.

2.1.1 Chemicals and Reagents

All chemicals and reagents used were of analytical standard and were obtained from reputable sources.

2.2.0 Preparation and Administration of Streptozotocin (STZ)

The range of diabetogenic dose of STZ is quite narrow and a light overdose may cause death of many animals (Lenzen *et al.* 1996).

Five gram of STZ was dissolved in 100 ml of distilled water to give a 5% stock solution of which a single dose of 70 mg/kg body weight was injected intraperitoneally to the rats.

2.2.1 Preparation of Plant Extract

Aqueous Extract

Fresh leaves and roots of the plant (*T. officinale*) were washed with distilled water to remove debris and contaminants, after which they were dried. The leaves and roots were homogenized into fine powder respectively.

The aqueous pulverized plant leaves and roots were respectively prepared by weighing out 100 g of pulverized leaves and roots into 1-l of distilled water respectively. The resultant mixture was allowed to stand for 24 h with occasional shaking after which it was filtered. The filtrate was evaporated and dried to powder with the aid of a thermostatic water bath at a temperature of 50°C. An aliquot of the extract was prepared by dissolving 6 g in 50 ml and 10 g in 50 ml of distilled water respectively to form the two concentrations which served as stock crude drug and stored at 4°C.

Ethanolic Extract

Fresh leaves of the plant (*T. officinale*) were washed with distilled water to remove debris and contaminants, after which they were dried. The leaves and roots were homogenized into fine powder respectively. 100 g of powdered leaves and roots were soaked respectively in 500 ml of absolute ethanol and the resultant mixture was allowed to stand for 24 h with occasional shaking, after which it was filtered. The filtrate was evaporated with rotary evaporator and dried to powder with the aid of a thermostatic water bath at 45°C.

2.3 Extract Administration

The test rats were administered 300 mg/kg and 500 mg/kg body weight of concentrations of aqueous and ethanolic extracts of leaves and roots respectively twice daily using a gavage via intubation for 21days, according to the experimental plan/grouping.

6% aqueous extract of leaves and roots were prepared respectively by weighing 6 g of the various extracts (aqueous and ethanolic) and dissolved in 50 ml of water.

[6000 mg in 50 ml (3000 mg in 25 ml)]

Each rat was administered 0.5 ml (e.g. 200 g rat) of the solution via intubation twice daily for 21days.

10% aqueous extract of leaves and roots were prepared respectively by weighing 10 g of the various extracts (aqueous and ethanolic) and dissolving in 50 ml of distilled water.

[10,000 mg in 50 ml (5000 mg in 25 ml)]

Each rat was administered 0.5 ml (e.g. 200 g rat) of the solution via intubation twice daily for 21days.

The mode of administration and treatment of the animals according to their experimental regimen/groups is shown in the Table below:

Figure 1: Leaf of *Taraxacum officinale* F.H. Wigg. found in wild.



Table 2.0 Feeding illustration.

GROUPS / TREATMENT	1	2	3	4	5	6	7	8	9	10	11	12	13	14
No. of Rats per group	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Feed + water	+	+	+	+	+	+	+	+	+	+	+	+	+	+
STZ(70 mg/kg) 0.2 ml	–	+	+	+	+	+	+	+	+	+	–	–	–	–
Aq. Leaves Extract 300 mg/kg	–	–	+	–	–	–	–	–	–	–	–	–	–	–
Aq. Leaves Extract 500 mg/kg	–	–	–	+	–	–	–	–	–	–	+	–	–	–
Et. Leaves Extract 300 mg/kg	–	–	–	–	+	–	–	–	–	–	–	–	–	–
Et. Leaves Extract 500 mg/kg	–	–	–	–	–	+	–	–	–	–	–	+	–	–
Aq. Roots Extract 300 mg/kg	–	–	–	–	–	–	+	–	–	–	–	–	–	–
Aq. Roots Extract 500 mg/kg	–	–	–	–	–	–	–	+	–	–	–	–	+	–
Et. Roots Extract 300 mg/kg	–	–	–	–	–	–	–	–	+	–	–	–	–	–
Et. Roots Extract 500 mg/kg	–	–	–	–	–	–	–	–	–	+	–	–	–	+

Key: + Indicates that item was administered;
– Indicates that item was not administered.

2.4 METHOD OF BLOOD COLLECTION

Blood used for analysis was collected via the tail vein by dilating the tail veins with methylated spirit and xylene, after which the tip of the tail is cut off and analysis done immediately with the blood collected using an automated blood analyser.

2.4.1 ASSAY METHOD

2.4.2 Packed Cell Volume (PCV)

Microhaematocrit method was used. The sample was collected into a heparinized capillary tube and spun at 3000 rpm for 10 min. The resultant product consisting of packed cells, buffy coat and plasma was read with the reader and the values expressed in percentage volume.

2.4.3 Haemoglobin (Hb)

Haemoglobin level was assayed using the method of Baker *et al.* (1985). Drabkin's solution (4 ml) was introduced into a test tube and 0.02 ml of blood sample added. The test tube was stopped with a rubber cork and inverted several times for proper mixing. This was allowed to stand for 10 min at room temperature for complete conversion of cyanomethaemoglobin. This was read at 540 nm wavelength against blank (4 ml of Drabkin's reagent only). The absorbance of known standard was read alongside those of the sample.

2.4.4 White Blood Cell (WBC)

Turk's solution of 1.0% glacial acetic acid was used as the diluent. The 1: 20 dilution was then charged on an improved Neuber Chamber and counted. Values were expressed in $\times 10^9$ mg/dl.

3.0 RESULTS AND DISCUSSION

Table 3.1.1 PVC VALUES (in %vol.) OF NORMAL AND DIABETIC CONTROLS COMPARED TO DIABETIC TEST AND NORMAL TEST RATS TREATED WITH AQUEOUS AND ETHANOLIC EXTRACTS OF *T. officinale* LEAVES.

WEEK / GROUP	1	2	3
NCR	35.4 ± 2.51^{b}	36.4 ± 2.07^{b}	37.9 ± 0.86^{b}
DCR	34.2 ± 1.10^{a}	36.3 ± 2.75^{b}	36.0 ± 1.00^{b}
DTR on 6% Aq. Extract	33.4 ± 2.19^{a}	32.8 ± 2.39^{a}	35.2 ± 3.10^{b}
DTR on 10% Aq. Extract	33.2 ± 3.10^{a}	37.2 ± 2.05^{b}	36.4 ± 3.80^{b}
DTR on 6% Et. Extract	34.0 ± 2.73^{a}	32.6 ± 2.61^{a}	32.4 ± 3.71^{a}
DTR on 10% Et. Extract	35.8 ± 3.42^{b}	35.8 ± 1.50^{b}	36.5 ± 2.65^{b}
NTR on 10% Aq. Extract	36.6 ± 0.55^{b}	38.6 ± 1.14^{c}	37.9 ± 1.37^{c}
NTR on 10% Et. Extract	35.8 ± 0.84^{b}	36.0 ± 3.46^{b}	36.8 ± 2.28^{b}

NCR, normal control rats; DCR, diabetic control rats; DTR, diabetic test rats; NTR, normal test rats.
abc given in superscripts expresses the level of significance (changes) between the weeks and the various groups.
Results are Means ± Standard Deviation of triplicate determinations.

Values in the same column with different superscripts letters are statistically significantly at 95% confidence level ($P \leq 0.05$).

Table 3.1.2 PVC VALUES (in %vol.) OF NORMAL AND DIABETIC CONTROLS COMPARED TO DIABETIC TEST AND NORMAL TEST RATS TREATED WITH AQUEOUS AND ETHANOLIC EXTRACTS OF *T. officinale* ROOTS.

WEEK / GROUP	1	2	3
NCR	35.4 ± 2.51^{b}	36.4 ± 2.07^{a}	37.9 ± 0.86^{b}
DCR	34.2 ± 1.10^{a}	36.3 ± 2.75^{a}	36.0 ± 1.00^{a}
DTR on 6% Aq. Extract	35.4 ± 1.34^{a}	37.4 ± 0.89^{b}	35.8 ± 0.84^{a}
DTR on 10% Aq. Extract	37.4 ± 0.89^{b}	37.4 ± 2.41^{b}	35.9 ± 3.36^{a}
DTR on 6% Et. Extract	32.7 ± 3.88^{a}	35.8 ± 2.39^{a}	34.0 ± 3.54^{a}
DTR on 10% Et. Extract	38.2 ± 1.10^{b}	38.0 ± 1.58^{c}	37.6 ± 1.34^{b}
NTR on 10% Aq. Extract	33.6 ± 3.91^{a}	35.2 ± 3.07^{a}	35.2 ± 2.95^{a}
NTR on 10% Et. Extract	38.8 ± 0.84^{c}	37.4 ± 0.55^{b}	38.0 ± 1.22^{c}

NCR, normal control rats; DCR, diabetic control rats; DTR, diabetic test rats; NTR, normal test rats.
Results are Means ± Standard Deviation of triplicate determinations.
Values in the same column with different superscripts letters are statistically significantly at 95% confidence level ($P \leq 0.05$).

Table 3.2.1 Hb VALUES (in g/dl) OF NORMAL AND DIABETIC CONTROLS COMPARED TO DIABETIC TEST AND NORMAL TEST RATS TREATED WITH AQUEOUS AND ETHANOLIC EXTRACTS OF *T. officinale* LEAVES.

WEEK / GROUP	1	2	3
NCR	12.2 ± 0.80^{b}	12.8 ± 0.42^{c}	12.9 ± 0.33^{c}
DCR	10.9 ± 1.11^{a}	11.3 ± 1.24^{a}	12.2 ± 0.51^{b}
DTR on 6% Aq. Extract	12.0 ± 0.45^{b}	11.5 ± 0.83^{b}	11.9 ± 1.12^{b}
DTR on 10% Aq. Extract	11.7 ± 1.06^{a}	11.4 ± 1.72^{a}	11.6 ± 1.44^{a}
DTR on 6% Et. Extract	12.2 ± 0.20^{b}	12.5 ± 0.62^{b}	11.0 ± 1.78^{a}
DTR on 10% Et. Extract	12.0 ± 1.16^{b}	12.3 ± 0.68^{b}	12.3 ± 0.96^{b}
NTR on 10% Aq. Extract	12.2 ± 0.14^{b}	12.1 ± 0.46^{b}	11.6 ± 0.83^{a}
NTR on 10% Et. Extract	12.6 ± 0.17^{b}	12.5 ± 0.26^{b}	12.4 ± 0.32^{b}

NCR, normal control rats; DCR, diabetic control rats; DTR, diabetic test rats; NTR, normal test rats.
Results are Means ± Standard Deviation of triplicate determinations.
Values in the same column with different superscripts letters are not statistically significantly at 95% confidence level ($P > 0.05$).

Table 3.2.2 Hb VALUES (in g/dl) OF NORMAL AND DIABETIC CONTROLS COMPARED TO DIABETIC TEST AND NORMAL TEST RATS TREATED WITH AQUEOUS AND ETHANOLIC EXTRACTS OF *T. officinale* ROOTS.

WEEK / GROUP	1	2	3
NCR	12.2 ± 0.80^{a}	12.8 ± 0.42^{b}	12.9 ± 0.33^{c}
DCR	10.9 ± 1.11^{a}	11.3 ± 1.24^{a}	12.2 ± 0.51^{b}
DTR on 6% Aq. Extract	11.4 ± 0.45^{a}	11.0 ± 0.88^{a}	10.5 ± 1.30^{a}
DTR on 10% Aq. Extract	11.8 ± 0.86^{b}	11.4 ± 1.29^{a}	12.4 ± 0.25^{b}
DTR on 6% Et. Extract	11.5 ± 1.46^{a}	10.4 ± 0.38^{a}	10.6 ± 0.94^{a}
DTR on 10% Et. Extract	12.7 ± 0.48c	12.7 ± 0.52^{c}	12.2 ± 0.74^{b}
NTR on 10% Aq. Extract	11.2 ± 1.30^{a}	11.5 ± 1.16^{a}	12.1 ± 0.44^{b}
NTR on 10% Et. Extract	13.5 ± 0.56^{d}	13.1 ± 0.72^{c}	12.1 ± 0.13^{b}

NCR, normal control rats; DCR, diabetic control rats; DTR, diabetic test rats; NTR, normal test rats.
Results are Means ± Standard Deviation of triplicate determinations.
Values in the same column with different superscripts letters are not statistically significantly at 95% confidence level ($P > 0.05$).

Table 3.3.1 WBC VALUES (in X10^9/µl) OF NORMAL AND DIABETIC CONTROLS COMPARED TO DIABETIC TEST AND NORMAL TEST RATS TREATED WITH AQUEOUS AND ETHANOLIC EXTRACTS OF *T. officinale* LEAVES.

GROUP \ WEEK	1	2	3
NCR	8.0 ± 0.73^b	8.1 ± 0.45^b	8.1 ± 0.21^b
DCR	8.7 ± 1.52^b	8.8 ± 1.01^b	8.7 ± 0.99^b
DTR on 6% Aq. Extract	6.8 ± 0.89^a	6.8 ± 0.81^a	7.0 ± 0.15^a
DTR on 10% Aq. Extract	8.3 ± 1.51^b	8.1 ± 1.21^b	8.1 ± 1.31^b
DTR on 6% Et. Extract	9.2 ± 3.73^b	9.0 ± 2.61^b	8.5 ± 3.21^b
DTR on 10% Et. Extract	11.3 ± 2.30^c	10.7 ± 2.14^c	10.9 ± 1.99^c
NTR on 10% Aq. Extract	7.8 ± 4.79^a	7.9 ± 3.57^a	7.9 ± 2.69^a
NTR on 10% Et. Extract	7.6 ± 3.39^a	7.5 ± 2.87^a	7.7 ± 2.57^a

NCR, normal control rats; DCR, diabetic control rats; DTR, diabetic test rats; NTR, normal test rats.
Results are Means ± Standard Deviation of triplicate determinations.
Values in the same column with different superscripts letters are not statistically significantly at 95% confidence level ($P > 0.05$).

Table 3.3.2 WBC VALUES (in X10^9/µl) OF NORMAL AND DIABETIC CONTROLS CMPARED TO DIABETIC TEST AND NORMAL TEST RATS TREATED WITH AQUEOUS AND ETHANOLIC EXTRACTS OF *T. officinale* ROOTS.

GROUP \ WEEK	1	2	3
NCR	8.0 ± 0.73^b	8.1 ± 0.45^b	8.1 ± 0.21^b
DCR	8.7 ± 1.52^b	8.8 ± 1.04^b	8.7 ± 1.30^b
DTR on 6% Aq. Extract	4.9 ± 1.30^a	5.2 ± 1.58^a	5.1 ± 1.28^a
DTR on 10% Aq. Extract	7.7 ± 0.81^a	7.9 ± 0.18^a	7.7 ± 0.43^a
DTR on 6% Et. Extract	10.0 ± 0.61^b	10.1 ± 0.24^b	10.4 ± 0.81^b
DTR on 10% Et. Extract	7.8 ± 0.91^a	7.8 ± 0.64^a	7.6 ± 0.33^a
NTR on 10% Aq. Extract	4.9 ± 0.87^a	5.0 ± 0.13^a	4.9 ± 1.02^a
NTR on 10% Et. Extract	6.7 ± 0.64^a	6.7 ± 0.64^a	6.5 ± 0.38^a

NCR, normal control rats; DCR, diabetic control rats; DTR, diabetic test rats; NTR, normal test rats.
Results are Means ± Standard Deviation of triplicate determinations.
Values in the same column with different superscripts letters are not statistically significantly at 95% confidence level ($P > 0.05$).

DISCUSSION

A clear demonstration of the comparison between the effects of *T. officinale* leaves and roots as well as the mode of extraction on some haematological parameters such as PCV, haemoglobin levels and white blood cell count, can be drawn from the experimental results above.

The effect of the aqueous leaf extract compared to the roots on PCV from the result above, indicates that their was a gradual increase ($P \leq 0.05$) in PCV level of both the diabetic treated rats and the normal treated rats when compared to those of the ethanolic leaf extract. This shows that the mode of extraction (especially the aqueous) has a significant effect on the parameter ascertained. See tables 3.1.1 and 3.1.2.

On the other hand, it was noticed that the effects of the various extracts and plant parts (leaves and root) had no significant ($P > 0.05$) changes on the haemoglobin (Hb) levels and white blood cell counts of both the diabetic treated rats and normal treated rats as demonstrated in tables 3.2.1; 3.2.2 and tables 3.3.1 and 3.3.2.

Finally the values obtained from the investigation validates that the plant/herb *T. officinale* has little or no adverse side effects on the haematology of the test animals (diabetic treated rats and normal treated rats) when compared to that of the normal control rats and diabetic control rats which showed no significant change on Hb levels and WBC counts.

4.0 CONCLUSION

The result of this investigation affirms that dandelion (*Taraxacum officinale*) is a valuable herb and extremely versatile, as the whole plant can be used for medicinal as well as culinary purposes. As a medicinal plant, dandelion has been considered to be an aperient, diuretic, stimulant, anti-diabetic and detoxicant. Dandelion leaves are unique as a diuretic, a valuable alkalizer to the body; eaten regularly they assist the body to reduce excess acidity, oxygenate, purify and build blood, cleanse and regenerate cells. Dandelion leaves contain a significant amount of potassium, a mineral generally lost when using conventional medications. Its calcium content helps the bones (which play a role in blood generation), teeth and nerves.

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