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EFFECT OF TARTRAZINE ORALLY ADMINISTERED ON THYROID HORMONES AND THYROID STIMULATING HORMONE OF ALBINO RATS

[1]*Elekima Ibioku, [2]Nwachuku Edna Ogechi and [3]Ben-Chioma Adline Erinma

[1,2,3]Department of Medical Laboratory Science, Rivers State University, Port Harcourt, Nigeria.

***Corresponding Author: Elekima Ibioku**

Department of Medical Laboratory Science, Rivers State University, Port Harcourt, Nigeria.

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ABSTRACT

The effect of tartrazine orally administered on thyroid hormones and thyroid stimulating hormone on albino rats were evaluated. Thirty rats (30) weighing approximately 0.14kg were used for the experiment. The rats were divided into five groups namely C1, C2, C3, C4 and C5. Each group consist of six (6) rats. When the data obtained were analysed statistically, Group 1 (control) had 0.1900 ± 0.0872; 2.618 ± 0.6002 and 0.8300 ± 0.3712 for TSH, T4 and T3 respectively. Group 2 had 0.2000 ± 0.2800; 2.758 ± 0.3704 and 1.243 ± 0.3806 for TSH, t3 and t3 while group 3 had 0.1467 ± 0.0242; 2.893 ± 0.6330 and 0.9150 ± 0.2367 for TSH, T4 and T3 respectively. In addition, group 4 had 0.1100 ± 0.0179; 2.878 ± 0.1217 and 1.448 ± 0.2498 for TSH, T4 and T3 respectively and finally, group 5 0.0933 ± 0.0301; 3.447 ± 0.6836 and 1.230 ± 0.4808 respectively. The comparison between group 1 (control) and group 2, group 1 and group 3 and group 1 and group 4 were compared, TSH, T4 and T3 were not significant except in group 1 and group 4 were T3 was significant at $p<0.05$. When group 1 and group 5 were compared, TSH and T4 were significant at $p<0.05$ while T3 was not significant at $p<0.05$. This study revealed that oral intake of synthetic dye such as tartrazine especially in high doses led to increase in thyroid hormones and reduction in TSH of albino rats.

KEYWORDS: Tartrazine, Triiodothyronine (T3), thyroxine (T4), TSH.

1. INTRODUCTION

Food colorants are dyes that can impart colour when added or applied to food, drugs, or cosmetics.[1][2] They are used in food to preventing colour loss due to storage or processing, to perfect natural variations in food colour as well as to enhance the appearance of certain food products to meet consumers request and satisfaction. Today, food colorants are more strictly regulated than at any other time in history. Hence, any food colorant requires approval for use prior to its inclusion in food.[3] Food dyes are broadly divided into two namely synthetic and natural food dyes. Natural dyes are obtained from natural sources such as plant, animals, bacteria and so on while synthetic dyes are usually synthesized artificially using coal-tar (benzene-like structure). Examples of synthetic dye are carmoisine, brilliant blue, brilliant green, erythrosine, tartrazine and so on.[1] Tartrazine as a synthetic dye has been used in several industries such as the food, cosmetics, leather, plastics and even in the pharmaceutical industries.[1][4] It is commonly used colour all over the world mainly for yellow colouration, but can also be used with Brilliant Blue or Green to produce various green shades.[4] Tartrazine is commonly seen in food products such as candy, soft drinks (Mountain Dew), energy drinks, flavoured corn chips, cereals (corn flakes),cake mixes, pastries, custard powder, soups, sauces, powdered drink mixes, ice cream, ice pops, chewing gum, marzipan, jam, jelly, yogurt, noodles, certain brands of fruit squash, potato chips, biscuits, and in some honey products.[1][5]

Tartrazine has been implicated as one of the food additives which is most often responsible for allergic reactions.[4][6] The sides effects of tartrazine vary depending on the route of administration and the dose administered. It is relevant to know that the acceptable daily intake (ADI) of tartrasine in human is 0-7.5mg/kg bodyweight.[7][8] In toxicological studies on rats, some researchers revealed that tartrazine induces several adverse effects on kidney, liver, blood cells, etc.[1][9][10][11], reported that tartrazine induce adverse effects in learning and memory functions in animals as well as behavioural changes. Tartrazine has also been reported to have toxic potential to harm lymphocytes, hepatocytes and renal functional unit and it seems that they bind directly to DNA.[1][5] In human, tartrazine has also been reported to induce wide range of allergic reactions in sensitive or atopic individuals.[6] In this study, the effect of tartrazine on thyroid hormones and TSH of albino rats were considered.

The thyroid gland produces two main hormones; Triiodothyronine (T3) and Thyroxine (T4).[12] T3 and T4 thyroid hormones synthesis is partially controlled by

thyroid stimulating hormones (TSH) from the hypothalamus. The thyroid hormone play crucial role on growth, development, regulation of energy generation and metabolism throughout life.[13][14][15] Thyroid hormones are involved in other metabolic functions such as carbohydrate, fat and protein and vitamins metabolism.[12][16] Thyroid hormones also enhance oxygen intake, mitochondrial metabolism, catecholamine sensitivity with increased cardiac rate and contractility, regulate calcium and phosphorus metabolism.[17][18] Thyroid hormone is necessary for development of normal sexual characteristics.[16][17] Several factors have been reported to influence or affect normal thyroid functions such as drugs, chemicals (arsenic, chloroform etc.). However, in this study the effect of tartrazine on thyroid hormones and TSH of albino rats were considered.

3. MATERIALS AND METHODS

3.1. Materials

Materials used include lithium heparin specimen container, centrifuge, Micro-plate reader, refrigerator and automated pipette. T3, T4 and TSH ELISA kits purchased from Bio-Check, California, USA were used for the assay of these parameters.

3.2. Animals

Thirty (30) albino rats were purchase from University of Portharcourt animal farm, transported in a well-ventilated plastic cage and acclimatized for two weeks under normal condition in the animal house of Department Of Medical Laboratory Science, Rivers State University of Science and Technology, PortHarcourt. The animals were fed with marsh chicken feeds and water daily.

3.3. Administration

A total of 30 albino rats weighing approximately 0.14kg were used in this study. The rats were divided into five (5) groups namely; C1, C2, C3, C4 and C5 with each group consisting of 6 rats. They were treated orally using gavage method with a daily intake of 1.0ml of 0.0% (0.0g/kg), 1.0% (0.07g/kg), 1.5% (0.11g/kg), 2.0% (0.14g/kg) and 2.5% (0.18g/kg) respectively. The duration of the treatment lasted for 4 weeks.

3.4. Collection of Specimen

Cardiac puncture was performed aseptically to collect 5ml of fasting specimen into a lithium heparin bottles with minimum stasis and was well mixed. The whole blood was spun at 4000rpm for 5 minutes. The plasma was collected into another plan bottle for analysis of triiodothyronine (T3), thyroxine (T¬4¬) and thyroid stimulating hormones (TSH).

3.5. Statistical Analysis

Data obtained from the evaluation of TSH, T4 and T3 were statistically analysed using graph pad prism 5.03. Statistical tools used were mean, standard deviation and student statistical t-test.

4. RESULT

When the data obtained were analysed statistically, Group 1 (control) had 0.1900 ± 0.0872; 2.618 ± 0.6002 and 0.8300 ± 0.3712 for TSH, T4 and T3 respectively. Group 2 had 0.2000 ± 0.2800; 2.758 ± 0.3704 and 1.243 ± 0.3806 for TSH, t3 and t3 while group 3 had 0.1467 ± 0.0242; 2.893 ± 0.6330 and 0.9150 ± 0.2367 for TSH, T4 and T3 respectively. Group 4 had 0.1100 ± 0.0179; 2.878 ± 0.1217 and 1.448 ± 0.2498 for TSH, T4 and T3 respectively and finally, group 5 0.0933 ± 0.0301; 3.447 ± 0.6836 and 1.230 ± 0.4808 for TSH, T4 and T3 respectively. The comparison between group 1 (control) and group 2 (table 4.1), group 1 and group 3 (table 4.2) and group 1 and group 4 (table 4.3), TSH, T4 and T3 were not significant except in group 1 and group 4 were T3 was significant at $p<0.05$. When group 1 and group 5 were compared (table 4.4), TSH and T4 were significant at $p<0.05$ while T3 was not significant at $p<0.05$.

Table 4.1: Comparison of Tartrazine treated rats Group 1 (control) and Group 2 (0.07g/kg)

Parameter	TSH	T4	T3
Group 1(control:0.0g/kg)	0.1900 ± 0.0872	2.618 ± 0.6002	0.8300 ± 0.3712
Group 2 (0.07g/kg)	0.2000 ± 0.2800	2.758 ± 0.3704	1.243 ± 0.3806
pvalue	0.0872	0.6373	0.0860
tvalue	0.2070	0.4862	1.904
Remark	NS	NS	NS

Table 4.2: Comparison of Tartrazine treated rats Group 1 (control) and Group 3 (0.11g/kg)

Parameter	TSH	T4	T3
Group 1 (control:0.0g/kg)	0.1900 ± 0.0872	2.618 ± 0.6002	0.8300 ± 0.3712
Group 3 (0.11g/kg)	0.1467 ± 0.0242	2.893 ± 0.6330	0.9150 ± 0.2367
pvalue	0.2679	0.4579	0.6464
tvalue	1.173	0.7722	0.4729
Remark	NS	NS	NS

Table 4.3: Comparison of Tartrazine treated rats Group 1 (control) and group 4 (0.14g/kg)

Parameter	TSH	T4	T3
Group 1 (control:0.0g/kg)	0.1900 ± 0.0872	2.618 ± 0.6002	0.8300 ± 0.3712
Group 4 (0.14g/kg)	0.1100 ± 0.0179	2.878 ± 0.1217	1.448 ± 0.2498
pvalue	0.0523	0.3229	0.0069
tvalue	2.202	1.040	3.385
Remark	NS	NS	S

Table 4.4: Comparison of Tartrazine treated rats group 1 (control) and group 5 (0.18g/kg)

Parameter	TSH	T4	T3
Group 1 (control: 0.0g/kg)	0.1900 ± 0.0872	2.618 ± 0.6002	0.8300 ± 0.3712
Group 5 (0.18g/kg)	0.0933 ± 0.0301	3.447 ± 0.6836	1.230 ± 0.4808
pvalue	0.0280	0.0498	0.1378
tvalue	2.567	2.230	1.613
Remark	S	S	NS

Key: S=significant; NS= Not Significant.

5. DISCUSSION

The aim of this work is to detect the effect of tartrazine dye on thyroid hormone and thyroid stimulating hormone of albino rats. The result obtained when group 1 and 2; group 1 and 3 were compared, there was a non-significant increase in T3 and T4 and decrease in TSH of albino rats. The result obtain is in line with the report of[19], who reported a non-significant of T3 and T4 in textile workers exposed to azo dyes such as tartrazine. Daffallah et al., 2015, also reported that T3 and T4 were not affected when 0.1g/kg and 10mg/kg of tartrazine were fed to rats mixed with food for 12 weeks. However, results obtained in these groups when compared to the control (group 1) are contrary to the reports of[21] and[22], revealed increase in T4 when rats were treated with tartrazine. When group 1 and group 4 were compared, T3 was significantly increased while T4 and TSH were non-significantly increased and reduced accordingly. The comparison of group 1 and group 5 revealed that TSH was significantly reduced while T4 was significantly increased. There was a non-significant increase in T3. The increase in T3 and T4 is in line with the reports of.[21][22] However, the significant decrease in TSH is contrary to the reports of[20] and.[22]

[1][21], reported in their respective work reported that azo dyes such as tartrazine when administered into mammals, intestinal bio-transformation of the azo dyes occurs resulting in the production of metabolites which are super-reactive free radicals. These free radical and reactive oxygen species have been reported to cause distortion of organs such as the liver.[1][23][24]

The increases observed in T3 and T4 in group 4 and 5 could be as a result of heavy presence of reactive oxygen species or free radicals insulting the follicular cells of the thyroid gland were T3 and T4 are stored. These increase in T4 and T3 especially forced a corresponding reduced level of TSH in the albino rats. The increased levels of TSH cause hyper-stimulation of the thyroid gland resulting in increased T4 and T3. However, due to negative feedback mechanism, increase level of T4 and T3 stimulates reduced production of TSH from the pituitary.[12] The increase in T3 could also be as a result peripheral conversion of T4 to T3 vis–a-vis increase presence of 5'deiodinase due to morphological changes of the parenchymal cells of the liver because of the presence of reactive oxygen species during the bio-transformation of the dye. The results obtained indicated that the increase levels of T3 and T4 as well as the decrease level of TSH were dose-dependent, that is, the significant increases were seen when the doses were also increased.

6. CONCLUSION

This study has shown that the intake of synthetic dye such as tartrazine could lead to thyroid hormones and TSH disturbances especially when taken excessive above the acceptable daily intake (0.0 – 7.5mg/kg bodyweight.

7. RECOMMENDATION

The indication from this study showed that repeated or increase intake of carmoisine and tartrazine dye can affect the thyroid hormone either directly or indirectly, not just that it could lead to pituitary gland damage that affects the thyroid gland but can also lead to hormonal imbalance. It is therefore, recommended that the use of synthetic dye in high concentration should be discouraged.

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