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Bio-implication of Environmentally Exposed Malted Product (Canned and Plastic Maltina) on Some Biochemical Indices of Albino-Rats

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Abstract

Environmentally exposed carbonated drinks have no biological value, rather a long-term damaging effect when accumulated in the tissues as discovered in this work. This research was carried out to investigate the biochemical effect of exposing non-alcoholic drinks to direct sunlight or adverse environmental conditions. The experimental set up was made up of maltina products consisting of the exposed (Canned and plastic) sample to sunlight for period of fifteen days alongside the unexposed sample as control. Proximate analysis was carried out on the maltina samples. Environmental exposure effect on the product was investigated on animal model experiment. Twenty-four (24) male rats of *wistar* strain weighing 120 - 140g divided into four (4) groups of six rats, each. Assessment of liver marker enzymatic; alanine aminotransferase (ALT), aspartate aminotransferase (AST) and alkali phosphatase (ALP); and non-enzymatic (albumin and bilirubin) parameters were investigated. The proximate analysis, vitamins and mineral evaluation showed a decrease in the protein, vitamins and calcium content upon exposure. Assessment of the liver function in rat's serum of the experimental groups showed a significant increase ($p < 0.05$) in ALP, AST, ALT and bilirubin, decrease in the albumin level compared with the control unexposed maltina sample groups. The findings showed that environmentally exposed maltina elicit adverse biochemical and physical changes and therefore portends greater long term toxicological effect with deleterious action.

Keywords: ***liver marker, proximate, vitamin, environment, mineral, maltina*.**

Introduction

Malt drink is a non-alcoholic beverage obtained from unfermented wort while Maltina is a brand of malt drink which is produced by mashing of grains to get sugar that is blended together with other essential ingredients which provide taste, colour, flavor, multivitamins and minerals. It is enriched with Vitamin A, B_1, B_2, B_3, B_5, B_6, C and calcium which makes it to be positioned as the drink that can deliver superior nourishment for an active, vibrant life for all (Ristovska, 2012).

The raw materials used for production of maltina include malt, mated sorghum, raw sorghum and maize grist, hops, water with additives such as amylex, calcium chloride (CaCl), maltina complex (vitamin A, B complex and C), caramelized dextrose maltase (CDM) and lactic acid (Chaudhari, 2010).

Effect of sunlight on the bottled or canned drink is that Polyethylene terephthalate (PET), the material commonly used to make the plastic bottles in which bottled drink is sold can leach into the content at high temperature. The contents of the PET bottle, and the temperature at which it is stored, both appear to influence the rate and magnitude of leaching of organic and inorganic compounds from PET bottle (Peter, 2008). Several studies have shown the presence of compounds in canned or plastic content, in non-negligible concentrations thereby raising concern on possible health implications (Mutsuga, 2006). Many laboratory animal and human studies have linked exposures to bisphenol A in Cans Polyethylene terephthalate (PET) and to adverse health effects, including altered behavior and obesity in children, reproductive abnormalities, cardiovascular changes, and various cancers (Stump *et al.,* 2010). Though, in the food industry, food (chemical) additives are added purposely to enhance quality (Abdulmumeen et al., 2012). While some are intentionally added, some others become part of food unintentionally occurring only in trace amount due to food packaging, storage and other handlings (Cavanaugh, 2002).

Moreso, Undernutrition is one of the aspects of malnutrition that is presently of global public health concern (W.H.O. 2018). Healthy eating is currently being advocated as a strategy to combat deficiency diseases associated with insufficient nutrient intake (Fraser, 2012). Maltina is a good source of fat and contains high quality proteins in addition to carbohydrates, vitamins, and minerals particularly calcium, magnesium. Consumers expect that the malted

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drinks they buy contains the nutritional qualities promised on the label, however, exposure to sunlight during the distribution/storage process can significantly erode the nutritional content of malted drinks Noluma Light Protection. (2019).

The reasons that prompted us to investigate Nutritional composition and the bioimplication of environmentally exposed malted product (maltina brand) on some biochemical parameters in albino-rats are centered on the facts that Maltina as a malt drink which is produced by mashing of grains to get sugar that is blended together with other essential ingredients which provides taste, colour, flavor, multivitamins and minerals, on exposure to sunlight, these essential ingredients could be broken down or altered to some by products alongside the leaching of Polyethylene terephthalate (PET) from the bottle into the maltina content which may be hazardous to health.

Liver and kidneys are considered as the primary targets for its toxico-pathological manifestations, and there are reports of biochemical alterations indicative of hepatic and renal system involvement.

Liver and kidneys are considered as the primary targets for toxico-pathological manifestations that might arise from environmental exposure. Maltina, a popular beverage drink has been consumed globally, especially in tropical region with harsh environmental conditions.

The nutritional content and biochemical properties maltina can be affected by environmental exposure which potentially impacting consumer health. Nevertheless, the of impact of environmental exposure on nutritional and biochemical properties of maltina is still unclear, as a result this study become necessary to embark on.

Materials and methods

Sample collection: The malted products both canned and plastic were gotten from Nigeria Breweries Limited, Markurdi plant in Benue State and transported on ice bath to cold room in Anyigba until required for use.

Treatment of samples: The products were exposed to adequate sunlight between 11: 00 am - 4:00 pm for 15 days with corresponding daily average temperature taken for each day as follow; 31 ^{o}C, 32 ^{o}C, 31 ^{o}C, 32 ^{o}C, 30 ^{o}C, 32 ^{o}C, 30 ^{o}C, 30^{o}C, 29 ^{o}C, 33 ^{o}C, 31 ^{o}C, 29 ^{o}C, 30 ^{o}C, 31 ^{o}C, 30 ^{o}C; for 15 days and average daily temperature was 30.7^{o}C. Proximate analysis was carried out before and after exposure to sunlight for 15 days, to determine the effects of the sunlight on the available nutrients in the malted products.

Experimental Animals: Twenty-four **(**24) adult male albino rats were purchased from the experimental animal house in Biochemistry Department, Faculty of Natural Sciences, Prince Abubakar Audu, Anyigba, Kogi State, Nigeria. They were housed in standard environmental conditions in the same animal facility. The experimental animals were fed with standard rodents' diets and clean water within the period of administration.

Weights measurement: The weights of the albino rats were taken before the commencement of the administration of the samples, on day seven (7), prior to the first phase of animal sacrifice and repeatedly taken at the end of week two on day fifteen (15).

Experimental design

Animal Grouping: Twenty-four adult male albino rats divided into 4 groups with 6 rats in a group was used for this Experiment. Group 1- rats were fed with normal feed and distilled water ad libitum (control group); group 2- rats were given oral administration of malt that is unexposed to the environment (unexposed group) 3ml; 1ml at a time in three separate administration/day + normal feed and water ad libitum. Group 3 rats were given oral administration of 3ml total of exposed canned maltina (3ml; 1ml at a time in three separate administration /day) + normal feed and water ad libitum. Group 4: rats were given oral administration of 3ml exposed Plastic maltina (3ml; 1ml at a time in three separate administration /day) + normal feed and water ad libitum (Plastic maltina). The twenty-four adult male albino rats were divided into 4 groups with 6 rats in a group.

Group 1: rats were fed with normal feed and distilled water *ad-libitum* (control group); **Group 2**: rats were given oral administration of malt that is unexposed to the environment (unexposed group) 3ml; 1ml at a time in three separate administration/day + normal feed and water ad libitum. **Group 3**: rats were given oral administration of 3ml total of exposed canned maltina (3ml; 1ml at a time in three separate administration /day) + normal feed and water ad libitum. **Group 4:** rats were given oral administration of 3ml exposed Plastic maltina (3ml; 1ml at a time in three separate administration /day) + normal feed and water *ad-libitum* (Plastic maltina).

Administration of Products: The malt product was administered orally using oral gavage. Administration of the product lasted for 15 days. Once daily at 24 hours interval. Three (3) rats were sacrificed from each group 24 hours after the 7th and 15th doses.

Animal sacrifice and preparation of serum: After appropriate dose and the completion of the experiment, the rats were anesthesised with diethyl ether and sacrifice via cardiac puncture. The blood sample collected were collected into capped non-EDTA bottles, centrifuged using Heraus-Christ GMBH Osterode refrigerated centrifuge at 4000rpm for 30 minutes and the serum collected using a Pasteur's pipette. This was stored in a refrigerator for biochemical analysis.

Proximate composition and energy value: The proximate composition of the maltina samples was determined using the Official Methods of Analysis of AOAC (2000). However, the carbohydrate content was then estimated by difference. The energy value of sample-type was calculated using a formula reported by Sanchez-Pena *et al.* (2016). Total energy value (Kcal/100g) = (4 x % protein) + (4 x % carbohydrate) + (9 x % fat).

Determination of biochemical parameters: The biochemical parameters (AST, ALT, ALP, Direct Bilirubin and Total Bilirubin) were measured using colorimetric method as described by (Reitman and Frankel, 1957; Haussament, 1977; Rutkowski and Debaare, 1966), as outlined in Randox Laboratory test kits.

Data Analysis: This was conducted using One-way ANOVA, SPSS version 20.0 software. Results were expressed as mean ± standard deviation of triplicate values. Separation of Mean was conducted for test of significance at ($p > 0.05$).

Results

Table 1: Proximate composition and energy value of unexposed, exposed canned and plastic maltina sample

Sample	Protein Content (%)	Fat Content (%)	Carbohydrate Content (%)	Energy value (kcal)
Unexposed Maltina	0.20 ±0.01^{b}	0.10 ± 0.01^{b}	14.40 ± 0.30^{a}	61.47 ± 2.05^{a}
Exposed (Canned) Maltina	0.11 ± 0.01^{a}	0.08 ± 0.01^{a}	14.20 ± 0.30^{a}	59.60 ± 3.30^{a}
Exposed (Plastic) Maltina	0.13 ± 0.02^{a}	0.10 ± 0.01^{b}	14.13 ± 0.20^{a}	60.94 ± 2.11^{a}

Values are expressed as mean ± SEM (where n = 3). Values with the same alphabet in the same column are not significantly different at (p > 0.05).

Proximate composition and energy value of unexposed maltina sample and the exposed canned and Plastic Maltina Samples (Table 1) shows that there was significant decrease ($p < 0.05$) in protein content between the unexposed and the exposed maltina samples group. Fat content; there was significant difference ($P < 0.05$) between the unexposed maltina and the exposed canned maltina sample group. No significant deference was observed in the carbohydrate and energy contents of all the groups ($P > 0.05$).

Table 2: Vitamins composition (mg/100ml) of unexposed, exposed can and plastic maltina samples

Sample	Vit. A	Vit.B_1	Vit.B_2	Vit.B_3	Vit.C
Unexposed Maltina	0.20 ± 0.03^{b}	0.10 ± 0.02^{b}	0.20 ± 0.03^{b}	2.00 ± 0.02^{c}	5.00 ± 0.01^{c}
Exposed (Canned) Maltina	0.14 ± 0.01^{a}	0.07 ± 0.01^{a}	0.18 ± 0.03^{a}	1.91 ± 0.01^{a}	3.04 ± 0.22^{a}
Exposed (Plastic) Maltina	0.18 ± 0.01^{a}	0.08 ± 0.02^{a}	0.20 ± 0.02^{b}	1.95 ± 0.02^{b}	4.04 ± 0.06^{b}

Values are expressed as mean ± SEM (where n = 3). Values with the same alphabet in the same column are not significantly different at (p > 0.05).

Vitamin composition of the samples in Table 2 shows that Vitamin A was significant difference ($p < 0.05$) higher in group administered unexposed maltina than those given exposed maltina samples. Vitamin B_1, B_2 and B_3 showed significantly different values in all the groups. Vitamin C showed significantly low value in the exposed maltina sample group compared to the unexposed.

Table 3: Mineral composition (mg/100ml) of the unexposed, exposed canned and plastic maltina samples

Sample	Ca	Na
Unexposed Maltina	45.0 ± 0.01^{b}	0.20 ± 0.01^{a}
Exposed (Canned) Maltina	38.27 ± 0.25^{a}	0.20 ± 0.01^{a}
Exposed (Plastic) Maltina	43.07±2.4^{b}	0.20 ± 0.01^{b}

Values are expressed as mean ± SEM (where n = 3). Values with the same alphabet in the same column are not significantly different at (p > 0.05).

Calcium content of the maltina samples in Table 3 showed that exposed Canned and Plastic maltina samples was significantly low ($p < 0.05$) compared to the unexposed group. There was no significant difference in sodium content for all the groups.

Table 4: Percentage weight-gain of rats in each group during fifteen (15) days of feeding (n = 6)

Sample	Average Initial Weight (g)	Weight increase in %	
	Day 0	Day 7	Day 15
Control	126	5 (6.3g)	9 (11.34g)
Unexposed Maltina	119	7 (8.3g)	11 (13.09g)
Exposed (Canned) Maltina	142	5 (7.1g)	9 (12.78g)
Exposed (Plastic) Maltina	123	6 (7.4g)	9 (11.07g)

Values are expressed as mean ± SEM (where n = 3).

Percentage (%) weight increase of animals in each group after the 7th and 15th day respectively of feeding is as shown in the Table 4 above; control (naive), 5% ,9%; positive control 7%, 11%; canned maltina 5%, 9% and plastic 6%, 9%

From Table 1, animals in the unexposed maltina group gained more weight than the animals in other groups. This variation in %weight gain by animals shows that the unexposed maltina sample has all its nutrients active which in turn gives the animals enough nourishment to gain such weight, while the environmentally exposed drinks might have been affected by environmental factors resulting in reduction of its nutrient.

Table 5: Effect of oral administration of unexposed, exposed canned and plastic maltina on serum levels of AST, ALT and ALP

	AST (U/ L)		ALT (U/L)		ALP (U/L)	
Group/Day	**7**	**15**	**7**	**15**	**7**	**15**
Control	70.47 ± 2.08^{a}	70.59 ± 2.87^{a}	19.67± 2.67^{a}	21.33±1.67^{b}	42.16± 1.30^{a}	42.01±1.16^{a}
Unexposed	71.28 ± 1.32^{a}	71.42 ± 2.27^{a}	20.00 ± 0.01^{a}	44.10 ±2.85^{b}	44.10 ±2.85^{b}	45.49±1.41
Exposed Can	75.42 ± 1.68^{c}	88.25 ± 3.01^{c}	22.03 ± 0.01^{b}	47.06± 2.05^{c}	47.06± 2.05^{c}	54.88±0.10^{c}
Exposed Plastic	73.32 ± 1.81^{b}	75.87± 1.73^{b}	21.33±1.67^{b}	21.33±1.67^{b}	46.22 ±1.5^{c}	56.70±1.93^{c}

Values are expressed as mean ± SEM (where n=3). Values with the same alphabet in the same column are not significantly different at (p > 0.05).

Enzyme assay of serum samples of albino rats: From the enzyme assay of the serum samples of albino rats in Table 5, the concentration of Aspartate aminotransferase (AST) was significantly difference ($p<0.05$) between the exposed groups and unexposed group after day 7 and day 15.

The concentration of Alanine aminotransferase (ALT) showed significant difference ($p<0.05$) between the unexposed group and the exposed group after day 7 and day 15. The concentration of alkaline phosphatase (ALP) showed significant difference ($p<0.05$) between the control, the unexposed group and exposed groups both at day 7 and day 15.

Table 5: Effect of oral administration of unexposed, exposed canned and plastic maltina on serum levels of Albumin, total Bilirubin and Direct Bilirubin

	Albumin (g/dL)		Total Bilirubin (mg/dL)		Direct Bilirubin (mg/dL)	
Group/Day	**7**	**15**	**7**	**15**	**7**	**15**
Control	4.17 ± 0.12^{b}	4.57 ± 0.41^{b}	0.63 ± 0.05^{a}	0.68 ± 0.08^{a}	0.19 ± 0.02^{a}	0.21 ± 0.02^{a}
Unexposed	4.27 ± 0.08^{c}	4.58 ± 0.36^{b}	0.64 ± 0.18^{a}	0.64 ± 0.03^{b}	0.19 ± 0.05^{a}	0.20 ± 0.01^{a}
Exposed Can	3.23 ± 0.06^{a}	3.17 ± 0.33^{a}	1.67 ± 0.16^{b}	1.74 ± 0.08^{c}	0.32 ± 0.05^{b}	0.33 ± 0.03^{b}
Exposed Plastic	3.10 ± 0.18^{a}	3.30 ± 0.17^{a}	1.64 ± 0.21^{b}	1.70 ± 0.11^{c}	0.41 ± 0.06^{b}	0.44 ± 0.04^{b}

Values are expressed as mean ± SEM (where n=3). Values with the same alphabet in the same column are not significantly different at (p > 0.05).

Liver function test presents the following: From Table 6 above; at day 7 and 15, albumin values for exposed canned and exposed plastic groups had significantly low ($p < 0\ 05$) result compared to the unexposed and the control groups. This hypoalbuminemia result indicates some damages to the liver and the kidney in the affected groups.

Total bilirubin: the value for the exposed canned maltina has significant difference ($p<0.05$) from the other groups at day 7, while at day 15, both the exposed canned and exposed plastic are significantly high ($p<0.05$) from other groups.

Direct bilirubin: at day 7, the values showed no significant difference in all the groups. But at day 15, both exposed canned and plastic maltina groups have significantly different values from other groups. This implies that there were damages done to the liver.

Discussion

Light energy in the ultraviolet and visible light regions plays a critical role in overall food quality, leading to various degradation and oxidation reactions (Duncan and Chang, 2012). Food degradation and oxidation result in the destruction of nutrients and bioactive compounds as seen in the proximate analysis result which is verifiable in the body weight gain of the animals in their respective groups. Therefore, any loss in nutrient quality of maltina drink used in this research work could be as a result of display of the product to direct sunlight and other unfavourable environmental conditions. Vitamins are some minerals are highly sensitive, and can be be affected by a variety of factors such as temperature, light, oxygen, pH, reducing agents, oxidising agents, metal ions etc Yenny., *et al* (2022). So, in line with the work of Yenny, *et al* (2022), results from proximate composition, vitamins and minerals of the environmentally exposed malted products showed some level of reduction compared to unexposed maltina drink.

ALT and AST are cytosol enzymes more often used as a complementary indicator of liver damage. For their observed significant increase in the serum as seen during the course of this research, it implies that the integrity of the membrane of liver cell have been compromised. This is evident particularly in the high level of activities of ALT in the serum of the exposed group maltina.

Conclusion

Proximate composition and energy, Vitamins composition, Mineral composition and Liver function tests both enzymatic and non-enzymatic have shown that environmentally exposed carbonated drinks have no biological value, rather a long-term damaging effect when accumulated in the tissues as discovered in this work

Decelerations

Ethics approval and consent to participate

Take from the Institute.

Conflicts of Interest

The authors declare no conflict of interest.

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Authors' contributions

Equal contribution of both author

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References

[1] Reitman S, Frankel A.S. (1957). A colorimetric method for the determination of serum glutamic oxaloacetate and glutamic pyruvic transaminase. Am. J. Pathol. 28: 56 - 63. 1957.

[2] Haussament TU. (1977). Quantitative determination of serum alkaline phosphatase. Clin. Chim. Acta 35: 271 - 273.

[3] Rutkowski RB, Debaare L. (1977). An ultra-micro colorimetric method for determination of total and direct serum bilirubin. Clin. Chem.12: 432 - 438.

[4] Abdulmumeen, H. A., Ahmed, N. R. and Agboola, R. S. (2012). Food its preservatives, additives and applications.

International Journal of Chemical and Biochemical Sciences, 1:36 - 47.

[5] Cavanaugh, T. A. (2002). Bioethics, 4/17 Medical Ethics. Blackwell Publishing Limited, England.

[6] Olajide, J. E., Akanji, M. A. and Idaikwo, M. A. (2014). Modulation of Enzyme Activities Following the Co-Administration of Potassium Bromate and Chloroquine in Selected Tissues and Serum of Albino Rats.

[7] W.H.O. (2018). Malnutrition. Retrieved April 17, 2019, from World Health Organization website: https://www.who.int/news-room/fact-sheets/detail/malnutrition

[8] Noluma L. P. (2019). Packaged foods should be kept in the dark. Retrieved from https://www.noluma.com/wp-content/uploads/2019/01/noluma-white- paper.pdf.

[9] Fraser, A. (2012). Food safety education for educators. Retrieved November 20, 2019, from http://www.foodsafetysite.com