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BISPHENOL A (BPA) INCREASES BLOOD TRIGLYCERIDES AND LOW DENSITY LIPOPROTEINS IN ALBINO WISTAR RATS

Oguazu C.E.[1,2] and Ezeonu F.C[2]*

[1]Department of Applied Biochemistry,
Nnamdi Azikiwe University, Awka, Nigeria
[2]Department of Biochemistry,
Gregory University, Uturu, Abia State, Nigeria
***Author for Correspondence:** fc.ezeonu@unizik.edu.ng*

ABSTRACT

Bisphenol A (BPA) is a component of polycarbonate and other plastics including resins that line food and beverage containers. BPA is known to leach from these products into containerized foods and drinks, and is therefore thought to be routinely ingested. In this present study the possible effect of BPA on blood lipid metabolism were investigated in rats. Female albino Wistar rats were administrated oral doses of 50, 100, 150, 200, and 250 µg BPA/kgbw/day once to determine effect of acute exposure and repeatedly for seven days in another set of test animals to determine the effects of sub-chronic exposure. Following the treatment, serum levels of lipid parameters were examined using the Chemwell Chemical Analyser. All data were expressed as means ± SD. The result of the study revealed that BPA increased blood triglycerides and LDL of exposed rats at both acute and sub-chronic phases

Keyword: Acute administration, sub-chronic administration, bisphenol A (BPA), blood lipid status.

INTRODUCTION

Bisphenol A (BPA) is a chemical found in many items that humans use daily such as water bottles, metal can linings, dental sealants, toys, and other products, including polycarbonate plastics, and can leach out of these products, especially when exposed to heat or acidity Welshons et al. (2006). It is increasingly being identified as a pervasive industrial pollutant as well, and accumulating evidence indicates that the human population is widely exposed to BPA (Broton et al. 1995). Small amounts of BPA can migrate from the polymer to food and water especially when heated (Lang et al. 2008).

Great concern about the compound arose from the fact that abundant scientific reports have demonstrated that it can interfere with endocrine signaling pathway at doses below the calculated safe dose during fetal, neonatal and perinatal periods as well as in adulthood. The first evidence that BPA exposure could lead to altered metabolic features was provided by Rubin et al (2001) *In utero* exposure to BPA has been shown to cause adverse effects such as accelerated puberty and increased body weight (Honma et al. 2002). Being lipophillic, BPA accumulates in human fat (Fernandez et al. 2007).

Study has shown that BPA provokes an increase in body weight (Howdeshell et al. 1999) and adipose tissue weights (Miyawaki et al. 2007). These results suggest the possibility that BPA may be contributing to the world wide epidemic of obesity. There are conflicting reports however on how bisphenol A affects the different cholesterol fractions in the body. This study is an attempt at resolving such conflicts; it elucidates the pattern of influence that bisphenol A exerts on blood lipid profile of exposed albino rats at graded low doses of acute and sub-chronic exposure.

MATERIALS AND METHODS

Seventy two (72) non-pregnant female rats of age 9 weeks were acclimatized in the laboratory for seven days and randomly divided into two equal groups of 36 rats each. Each group was further subdivided into six experimental groups each containing six (6) rats and respectively administered 50, 100, 150, 200, and 250 µg BPA/kgbw/day. The sixth group which served as control did not receive any treatment but double distilled water instead. The respective concentrations of BPA were dissolved in double distilled water and administered by oral gavage using intubation

canular. Blood were obtained from the first groups by cardiac puncture one hour after BPA administration and the animals sacrificed by suffocation with formalin soaked in cotton wool in a glass jar. Blood samples were processed for lipid assay and the serum levels of lipid parameters were determined using the Chemwell®Chemical Analyser.

The second groups of experimental rats were similarly treated like the previous group except that treatment was sustained daily for seven (7) days to ascertain sub-chronic effects. Animals were housed in aluminum wire-mesh cages in a well-ventilated animal house with a 12 h dark/light cycle and at room temperature and were provided commercial rat pellets (Vital feed from Vital group of Company, Nigeria) and water *ad libitum*. The body weights were measured daily for the seven (7) days.

RESULT

The body weight of the test animals expressed as mean body weight ± SD are shown in figure 1. The entire test group showed gradual and consistent increase in body weight from day 1 through day 7. These increases were found to be statistically significant in all instances. It was however observed that the test group with the least dose (50µg/kg bw BPA) had the highest percentage body weight gain. The results revealed that as the dose increased, the marginal weight gain decreased. That is to say that the gain in body weight is inversely dose dependent.

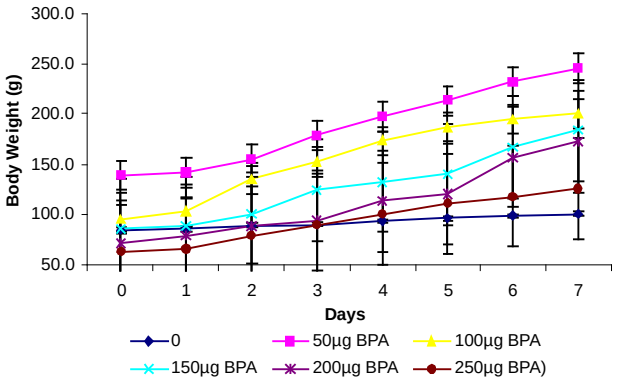

Figure 1: Mean body weights after oral administration of BPA.

Serum cholesterol levels were significantly low in BPA treated groups when compared to control group at both instances of acute and sub-chronic exposure, but high at 150µg/kg of acute phase (see figures 2(a) and 2(b)). The reason for the cholesterol outlie at 150µg BPA/kgbw/day test animals is not obvious. Significantly high serum triglycerides levels were observed at acute and sub-chronic exposures compared with the control except again for the test animals administered 150µg/kg at acute phase (see figures 2(a) and 2(b)). The reason for this variation is not obvious but it is apparent that there is an apparitional difference in the cholesterol-triglyceride metabolism in this group of test animals compared with the other groups.

Fig. 3(a) and 3(b) show the serum low density lipoprotein cholesterol (LDL-C) and high density lipoprotein cholesterol (HDL-C) levels. In almost all test doses in the two instances of exposure (acute and sub-chronic), a significant increase in serum LDL-C levels were observed. This rise in LDL-C values is apparently not dose-dependent. Significantly low serum HDL-C levels were observed at acute exposure doses but reversed effect was observed in sub-chronic exposure cases.

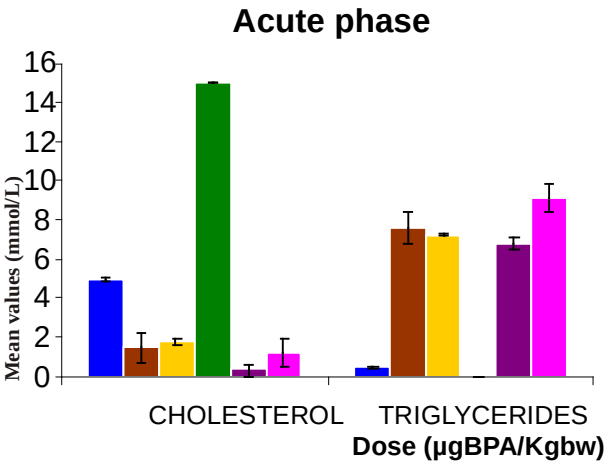

Fig.2a. Cholesterol and Triglycerides

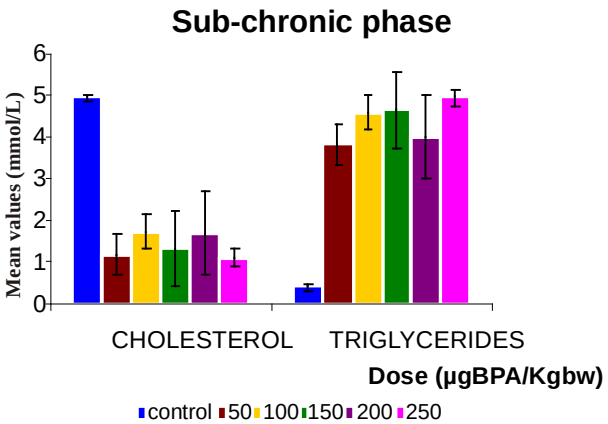

Fig.2b. Cholesterol and Triglycerides

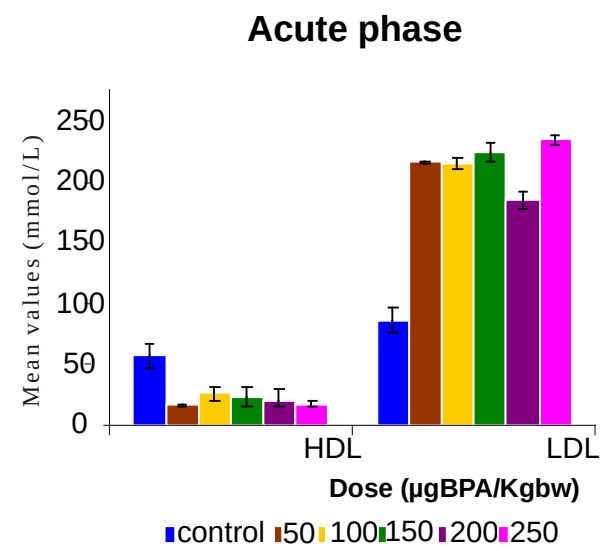

Fig. 3a Serum HDL-C and LDL-C

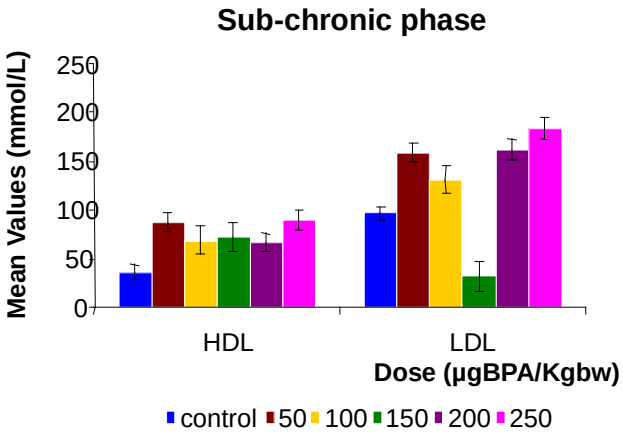

Fig. 3b. Serum HDL-C and LDL-C

DISCUSSION

The result of this study is consistent with many other reports which suggest that BPA encourages weight gain in exposed animals. Increased body weight of experimental animals exposed to BPA for several days have variously been reported for various doses; 0.5 and 10 mg BPA/kg BW/day (Nikaido et al. 2004), 0.0024 mg BPA/kg (Howdeshell *et al. 1999) and* 50µg BPA/kg BW/day (Patisaul and Bateman, 2008).

The test results of the seven day administration of graded doses will give a better picture of the overall metabolic effect of BPA on body lipids. The results show that the cholesterol level in test animals were significantly lower than control cases, while triglycerides and total lipids were significantly higher. This finding agrees with the earlier report of Miyawaki et al (2007) who observed that continuous exposure of mice to BPA during the perinatal and postnatal periods caused the development of hyperlipidemia. They also reported significant increases in total cholesterol, triglycerides, adipose tissue weight, leptin levels and body weight. Lang et al (2008) equally reported significant increases in low-density lipoprotein cholesterol (LDL-C), high-density lipoprotein cholesterol (HDL-C), total cholesterol and triglycerides. Except for the significantly low cholesterol levels and HDL-C at acute levels observed in our study, all other indices, triglycerides, total cholesterol and LDL-C increased significantly. Alanso-Magdalena et al (2010) had reported that BPA stimulates adipogenesis, this may account for the hyperlipidemia.

Given the potential of BPA to exert effects, it is likely that BPA exposure might influence several mechanisms important for body weight regulation and blood lipid status. The specific pathways and mechanisms affected by BPA exposure may be dependent upon the dose and the precise time of exposure. It is paramount that the potential effects of BPA exposure on body weight and lipid status be further investigated.

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REFERENCES:

Alonso-Magdalena P, Morimoto S, Ripoll C, Fuentes E, Nadal A. (2006). Eestrogenic effect of bisphenol A disrupts pancreatic beta-cell function *in vivo* and induces insulin resistance. Environ. Health Perspect. 114: 106–112

Alonso-Magdalena P, Laribi O, Ropero AB, Fuentes E, Ripoll C, Soria B, Nadal A. (2005). Low doses of bisphenol A and diethylstilbestrol impair Ca2+ signals in pancreatic alpha-cells through a nonclassical membrane estrogen receptor within intact islets of Langerhans. Environ. Health Perspect. 113: 969–977.

Brotons JA, Olea-Serrano MF, Villalobos M, Pedraza V,

Olea N. (1995). Xenoestrogens released from lacquer coatings in food cans. Environ Health Perspect. 103: 608–612.

Fernandez MF, Arrebola JP, Taoufiki J, Nafalón A, Ballesteros O, Pulgar R, Vilchez JL, Olea N.(2007). Bisphenol-A and chlorinated derivatives in adipose tissue of women. Reprod. Toxicol. 24: 259–264

Honma S, Suzuki A, Buchanan DL, Katsu Y, Watanabe H, Iguchi T. (2002). Low dose effects of *in utero* exposure to bisphenol A and diethylstilbestrol on female mouse reproduction. Reprod. Toxicol. 16: 117–122

Howdeshell KL, Hotchkiss AK, Thayer KA, VandenberghJG, vom Saal FS. (1999). Exposure to bisphenol A advances puberty. Nature. 401: 763–764.

Lang IA, Galloway TS, Scarlett A, Henley WE, Depledge M, Wallace RB, Melzer D. (2008). Association of urinary bisphenol A concentration with medical disorders and laboratory abnormalities in adults. J. Am. Med. Assoc. 300: 1303–1310

Miyawaki J, Sakayama K, Kato H, Yamamoto H, Masuno H. (2007). Perinatal and postnatal exposure to Bisphenol A increases adipose tissue mass and serum cholesterol level in mice. J. Atherosclerosis Thrombosis. 14: 245–252

Nikaido Y, Yoshizawa K, Danbara N, Tsujita-Kyutoku M, Yuri T, Uehara N, Tsubura A. (2004). Effects of maternal xenoestrogen exposure on development of the reproductive tract and mammary gland in female CD-1 mouse offspring. Reprod. Toxicol. 18: 803–811

Newbold RR, Jefferson WN, Padilla-Banks E. (2007). Long-term adverse effects of neonatal exposure to bisphenol A on the murine female reproductive tract. Reprod. Toxicol. 24: 253–258

Newbold RR, Padilla-Banks E, Jefferson WN, Heindel JJ. (2008). Effects of endocrine disruptors on obesity. Int. J. Androl. 31: 201–208

Patisaul HB, Bateman HL. (2008). Neonatal exposure to endocrine active compounds or an ERbeta agonist increases adult anxiety and aggression in gonadally intact male rats. Hormones Behav. 53: 580–588

Rubin BS, Murray MK, Damassa DA, King JC, Soto AM. (2001). Perinatal exposure to low doses of bisphenol-A affects body weight, patterns of estrous cyclicity and plasma LH levels. Environ. Health Perspect. 109: 675–680

Welshons WV, Nagel SC, vom Saal FS. (2006). Large effects from small exposures III. Endocrine mechanisms mediating effects of bisphenol A at levels of human exposure. Endocrinology. 147: S56–S69