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Effect of Prenatal and Postnatal Exposure to an Aqueous Extract of *Hibiscus sabdariffa* (HS) on Postnatal Growth in Sprague-Dawley Rats

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Abstract: The present study was designed to investigate whether pups exposed to aqueous extract of HS during the foetal period and during early postnatal period would have a comparable growth with control pups in accordance with the "predictive adaptive response" hypothesis. Three groups of pregnant Sprague-Dawley (SD) rats were used for this study. Group C had tap water while groups A and B had 0.6g/100ml and 1.8g/100ml HS extract respectively to drink throughout pregnancy and through 20 days postpartum. All groups had normal rat chow *ad libitum*. Dam weights were recorded daily throughout pregnancy and through 20 days postpartum while pup weights were recorded at birth, 10 days, 14 days and 20 days postpartum. Results of the present study show no statistically significant difference ($p>0.05$) in the growth of pups at 10, 14 and 20 days postpartum in all groups except for group B pups whose growth was lower ($p<0.05$) at 20 days postpartum. We conclude that prenatal and early postnatal exposure to an aqueous extract of Hibiscus Sabdariffa does not appear to affect early postnatal growth in Sprague-Dawley rats.

Key words: Prenatal and postnatal exposure, *Hibiscus sabdariffa*, postnatal growth

Introduction

The "Predictive Adaptive Response" (PAR) hypothesis (Gluckman and Hansen, 2004a,b,c) propose that the offspring makes adaptations inutero (or in the early postnatal developmental period) based on the predicted postnatal environment. When this prediction is appropriate, the phenotype is normal, however, where mismatch occurs between the predicted and actual environment, disease manifests. PAR also contends that in response to a given inutero or early postnatal (lactational) nutritional plane (either high or low), cellular processes are tuned to cope with the predicted environment. Thus it is proposed that disease only manifests when the postnatal diet deviates from the nutritional plane predicted by the foetus (Armitage *et al*., 2004, 2005).

Zobo drink (a sweetened water extract of the dry petals of HS) is commonly produced, sold and consumed in Nigeria without caution by both males and females. It is consumed as a substitute for carbonated drinks and fruit juices and not necessarily for medicinal purposes. Some people have been observed consuming zobo drink during pregnancy and lactation.

Aqueous extract of HS has been shown to decrease maternal food consumption (Orisakwe *et al*., 2003; Orisakwe *et al*., 2004; Ojokoh, 2006) through a mechanism not yet understood. This decreased food intake causes maternal and foetal nutrient stress and the consequent programming of the structures and functions.

In our earlier study, *In utero* exposure to an aqueous extract of HS severely attenuated early postnatal growth (Iyare and Iyare, 2006a) whereas lactational exposure to same aqueous extract of HS accelerated early postnatal growth (Iyare and Iyare, 2006b).

The present study therefore was designed to investigate whether pups exposed to aqueous extract of HS during pregnancy and during lactation would have a comparable growth with control pups in accordance with the "predictive adaptive response" hypothesis.

Materials and Methods

The procedure used in the extraction of HS was as described previously (Iyare and Iyare, 2006a,b). Briefly, 30g of the dry petals of HS was brewed in 400ml of boiled tap water for 45min. The resulting decoction was filtered using a filtration sieve. 10ml of the filtrate was evaporated to dryness and yielded 0.3665±0.002g, giving a concentration of 0.03665±0.002g/ml.

The concentrations in the exposed groups (groups A and B) below were derived as follows: 10mls of filtrate was added to 48mls of tap water to make approximately 0.6g/100ml tap water (group A) while 10mls of filtrate was added to 9mls of tap water to make approximately 1.8g/100ml tap water (group B).

Three groups of pregnant Sprague-Dawley (SD) rats were used for this study. Group C had tap water while groups A and B had 0.6g and 1.8g HS extract respectively in 100ml tap water to drink throughout pregnancy and through 34 days postpartum. All groups had normal rat chow *ad libitum*. Dam weights were recorded throughout pregnancy and lactation, while pup weights were recorded at birth, 10 days, 14 days and 20 days postpartum.

Table 1: Postnatal weights (g)

Groups	Postnatal weights (g)			
	At birth	At 10 days	At 14 days	At 20 days
A	6.25±0.1	16.9±0.2	23.5±0.2*$	31.8±0.9$
B	6.5±0.2	16.9±0.5	21.7±0.3	26.3±0.8*
C	6.1±0.1	17.0±0.2	21.9±0.2	30.4±0.4*

*= p<0.05 vs control (C). $ = p<0.05 vs B

Table 2: Postnatal weight gain (g)

Groups	Postnatal weight gain (g)		
	At 10 days	At 14 days	At 20 days
A	10.6±0.3	17.3±0.3*$	25.5±0.9$
B	10.4±0.6	15.2±0.4	19.9±0.8*
C	10.9±0.2	15.8±0.2	24.3±0.4*

* = p<0.05 vs control (C). $ = p<0.05 vs B

Table 3: % Postnatal weight gain

Groups	% Postnatal weight gain		
	At 10 days	At 14 days	At 20 days
A	170.4±8.3	276.6±11.3	409.3±24.5$
B	165.7±14.4	239.8±12.1	313.0±18.2*
C	180.6±5.9	261.2±6.5	400.9±9.8

* = p<0.05 vs control (C). $ = p<0.05 vs B

Table 4: Postnatal weight gain in the 1st and 2nd 10 days postpartum

Groups	A	B	C
Postnatal weight gain (g)			
Birth weight (g)	6.25±0.1	6.5±0.2	6.1±0.1
1st 10 days (birth-10 days)			
Weight gain (g)	10.6±0.3#	10.4±0.6#	10.9±0.2#
% weight gain	170.4±8.3#	165.7±14.4#	180.6±5.9#
2nd 10 days (11 days-20 days)			
Weight gain (g)	14.9±0.9$	9.5±1.1*	13.4±0.4
% weight gain	88.3±5.9$	58.3±8.1*	78.9±2.6

* = p<0.05 vs control (C). $ = p<0.05 vs B. # = p<0.05 vs 2nd 10 days

Statistical analysis: Results are expressed as mean ± S.E.M. (standard error of mean). Statistical difference was calculated by one way ANOVA followed by a post hoc Students-Neuman-Keuls with level of significance taken as P<0.05.

Results

Results of the present study show no statistically significant difference in growth among the various groups except for group B pups that showed reduced growth (p<0.05) at 20 days postpartum relative to groups A and C pups (Tables 1-3).

Dividing the period of measurement into first 10 and second 10 days postpartum (Table 4) shows a significantly reduced growth (p<0.05) in group B pups relative to group A and C pups at the second 10 days. This probably accounted for the decreased growth in group B pups at 20 days (Table 3).

Discussion

The decreased weight gain observed in the exposed dams in this study during pregnancy and lactation may have been due to malnutrition caused by decreased food consumption by these dams occasioned by exposure to aqueous extract of HS. This is in agreement with several earlier reports (Orisakwe *et al*., 2003; Orisakwe *et al*., 2004; Ojokoh, 2006).

The resultant maternal malnutrition may have caused foetal malnutrition in utero thus indicating to the foetus that the current and therefore future nutritional environments are likely to be poor. This may have led to the foetus making the necessary cellular and/or hormonal adjustments necessary for a normal postnatal growth and survival under periods of continued postnatal malnutrition in accordance with the "PAR" hypothesis.

That there was no significant difference in the early postnatal growth between pups of exposed dams and pups of control dams may suggest an appropriate prediction of the postnatal environment (and a corresponding developmental adaptation) when the exposed pups were inutero. This is in accordance with "PAR" hypothesis since disease only manifests when there is a mismatch between the environment predicted inutero and the actual environment seen in postnatal life. Intriguingly, it also appears to be a fusion of our earlier works in which we observed that *in utero* exposure to an aqueous extract of Hibiscus Sabdariffa severely attenuated offspring's early postnatal growth (Iyare and Iyare, 2006a) while lactational exposure accelerated it (Iyare and Iyare, 2006b).

From the foregoing, we conclude that prenatal and postnatal exposure to an aqueous extract of HS does not appear to affect early postnatal growth.

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