

Effect of maternal cafeteria diet and taurine supplementation on plasma amino acid profile in adult offspring rats

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Received: 14.04.2026 • Accepted: 30.06.2026

ABSTRACT

Aim: Maternal taurine supplementation has been shown to exert protective effects following a maternal cafeteria diet on offspring growth and metabolism. However, the long-term effects of maternal cafeteria diet on offspring's metabolism and energy substrates remain unclear. This study aimed to examine the effects of maternal cafeteria diet supplemented with taurine on plasma amino acid profile in adult offspring rats.

Subjects and Method: Female Wistar rats (aged 4 weeks) were randomly allocated to be fed either a control chow diet (CON; n = 6), control chow diet supplemented with 1.5% taurine in drinking water (CONT; n = 7), cafeteria diet (CAF; n = 7), or cafeteria diet supplemented with 1.5% taurine in drinking water (CAFT; n = 7) for 8 weeks. Females were paired with a Wistar stud male, and mating was confirmed by the appearance of a semen plug. After weaning all offspring were fed a commercial chow diet until 20 weeks of age. At the age of 20 weeks, all offspring were culled and blood samples were taken by cardiac puncture.

Results: Male offspring had significantly higher plasma amino acid concentrations in comparison to female offspring (Effect of sex, $P < 0.05$). The concentrations of plasma essential amino acids in adult male offspring were similar between the groups (Effect of maternal diet, $P > 0.05$). Similarly, non-essential amino acids exhibited alike results in adult male offspring (Effect of maternal diet, $P > 0.05$). Plasma essential and non-essential amino acid concentrations were also similar in female offspring, indicating that neither maternal diet nor taurine supplementation influenced the amino acid profile in adult offspring.

Conclusion: Maternal diet plays a crucial role in shaping the plasma metabolites of offspring, which in turn affects their growth, metabolism, and health. Although current study did not show any significant results on plasma amino acid levels due to possible effects of longer post-weaning period, prolonged chow diet feeding or adapted effects to maternal programming, future studies will continue to investigate the effects of maternal taurine supplementation on amino acid and protein metabolism in the setting of maternal obesity.

Keywords: Cafeteria diet; Maternal obesity, taurine, rats, pregnancy

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INTRODUCTION

The most primary intrauterine environmental component that alters fetal morphology and function through a process known as fetal programming, is nutrition (1). During the prenatal period, both maternal undernutrition and overnutrition may exert negative health effects on the offspring (2,3). Previous animal models have reported that maternal exposure to obesogenic diets during the prenatal and/or early postnatal periods may result in metabolic disturbances like increased adiposity (4), insulin resistance (5) and inflammation (6) in the offspring.

Maternal cafeteria diet, characterized by feeding laboratory animals with highly energetic and palatable junk foods, can significantly impact the development of offspring (7). Maternal consumption of cafeteria diet can program the metabolism and body composition of the offspring, leading to increased body weight and adipose tissue, as well as higher levels of cholesterol, insulin, and leptin in the dams (8). The metabolic changes in the mother following cafeteria diet can predispose the offspring to metabolic issues, such as hyperglycemia, hyperinsulinemia, and hyperleptinemia, especially if the offspring continue to consume a cafeteria diet during post-weaning period (9). Therefore, the maternal cafeteria diet not only affects immediate developmental outcomes but also has lasting effects on the metabolic health and behaviour of the offspring, underscoring the importance of balanced maternal nutrition during pregnancy.

The maternal cafeteria diet is a well-established experimental model used to induce maternal obesity and metabolic disturbances and to investigate their effects on offspring. Within this experimental framework, several studies have evaluated whether nutritional interventions can attenuate the adverse outcomes induced by the cafeteria diet rather than optimize the diet itself. For instance, taurine supplementation in experimental models of maternal cafeteria diet exposure has been found to reduce fat deposition and alter hepatic gene expression patterns in offspring, thereby reducing the detrimental effects of the diet (10). Additionally, taurine supplementation normalized maternal plasma TNF- α and glutamate concentrations, suggesting a protective effect against inflammation (11). In a rat model, taurine supplementation reduced adipose tissue weights in male offspring and decreased plasma homocysteine concentrations in all maternal taurine-supplemented groups (12).

It is known that taurine, a sulphur-containing amino acid, plays a crucial role in fetal development, including the development of the pancreas and brain, and its requirements increase during pregnancy (13). However, the benefits and potential risks of taurine supplementation may depend on the maternal nutritional background and specific health

conditions being addressed. The need for further research is emphasized in order to optimize taurine supplementation strategies and understand possible mechanisms associated with re-programming effects of taurine. Accordingly, assessing the metabolic response of plasma amino acids with respect to maternal cafeteria diet supplemented with taurine is specifically important. Therefore, this study aimed to address the effects of maternal cafeteria diet supplemented with taurine on plasma amino acid profile in adult offspring.

METHODS AND MATERIALS

Experimental Protocol

Animals were housed individually in plastic cages under controlled environmental conditions, including a 12 h light–dark cycle, ambient temperature maintained between 20 and 22 °C, and relative humidity of approximately 45%. Wood shavings were used as bedding material, and both food and water were provided ad libitum throughout the study period. Following a 1-week acclimatization period, 4-week-old virgin female Wistar rats were randomly assigned to one of four experimental groups: standard chow diet (CON; n = 6), chow diet with 1.5% taurine supplementation in drinking water (CONT; n = 7), cafeteria diet (CAF; n = 7), and cafeteria diet with 1.5% taurine supplementation in drinking water (CAFT; n = 7). were initiated before mating and maintained throughout pregnancy and lactation until weaning. Female rats received the experimental diets for 8 weeks before mating, and the same dietary regimens were continued throughout gestation and lactation. After the dietary period, females were mated with Wistar males, and successful mating was verified by the presence of a vaginal plug. At parturition, litter sizes were standardized to eight pups per dam (four males and four females). Body weights of offspring were monitored daily until weaning. At the end of lactation, dams and a subset of offspring (three males and three females per litter) were euthanized following overnight fasting using carbon dioxide inhalation followed by cervical dislocation. After weaning, one male and one female offspring from each litter were maintained on a standard chow diet until 20 weeks of age (CON: M = 6, F = 6; CONT: M = 5, F = 8; CAF: M = 7, F = 7; CAFT: M = 7, F = 7). Body weight measurements were recorded regularly throughout this period. At 20 weeks of age, all remaining offspring were sacrificed. Blood samples were collected via cardiac puncture, and major organs were excised, weighed, and immediately frozen in liquid nitrogen for further analyses. The data presented in this study correspond to the offspring of the CON, CONT, CAF, and CAFT groups at 20 weeks of age. The complete experimental design has been described previously (10).

Maternal Diets

The cafeteria diet consisted of a standard chow base (6% fat, 71% carbohydrate, 23% protein; 2800 kcal/kg) supplemented with a rotating selection of highly palatable, energy-dense human foods, including biscuits, potato chips, corn snacks, milk chocolate, chocolate bars, kashar cheese, jelly candies, chocolate cake, and peanuts. Each day, four different cafeteria items were provided in excess amounts in addition to chow. To ensure dietary variety, two of the items were replaced daily, and no specific food item was offered for more than two consecutive days. Food and water intake were monitored daily between 09:00 and 10:00 by weighing the amounts provided and the leftovers. Energy and macronutrient intakes were calculated based on manufacturers' nutritional information, taking into account weight changes due to moisture loss, as previously describe (14). The cafeteria diet protocol was adapted from our previously published study (14). The taurine concentration (1.5% in drinking water) was selected based on previous experimental studies demonstrating its efficacy in maternal obesity models (11,12,18).

Plasma Amino Acid Concentration

Blood samples were collected into heparinized capillary tubes and kept on ice prior to centrifugation using a hematocrit centrifuge. Plasma was separated and stored at -80°C until analysis. Plasma amino acid concentrations were determined using a gas chromatography-based amino acid analysis kit (EZ:faast, Phenomenex, Torrance, CA, USA (15). Analyses were conducted using samples obtained from offspring at 20 weeks of age.

Statistical Analyses

All statistical analyses were performed using SPSS software (version 23; SPSS Inc., Chicago, IL, USA). Data distribution was assessed using the Kolmogorov–Smirnov test. Variables not meeting normality assumptions were transformed prior to further analysis to ensure normal distribution and homogeneity of variance. A three-way analysis of variance (ANOVA) was applied to evaluate the effects of maternal diet, taurine supplementation, and sex, as well as their interactions. Results are presented as mean $\pm$ standard error. Statistical significance was defined as $p < 0.05$. All experimental procedures were conducted in accordance with national guidelines for the care and use of laboratory animals and were approved by the Institutional Ethics Committee of Hacettepe University, Ankara, Türkiye (approval number: 2015/01).

RESULTS

Male offspring had significantly higher plasma amino acid concentrations in comparison to female offspring (Effect of sex, $P < 0.05$). The concentrations of plasma essential amino acids in adult male offspring is presented in Table 1. Although plasma phenylalanine, histidine, isoleucine, lysine, leucine, threonine and valine levels exhibited lower concentrations in CON, CAF and CAFT when compared to CON, maternal diet and taurine did not exert any significant effect on plasma amino acid concentrations of essential amino acids in adult male offspring ($P > 0.05$).

Table 1. Plasma amino acid concentrations of essential amino acids in adult male offspring

Male offspring, Essential Amino acids ($\mu\text{mol/L}$)	CON	CONT	CAF	CAFT
Phenylalanine	974.89 $\pm$ 43.03	886.57 $\pm$ 47.14	877.85 $\pm$ 39.84	888.47 $\pm$ 43.03
Histidine	152.62 $\pm$ 5.93	132.78 $\pm$ 6.50	143.43 $\pm$ 5.49	132.97 $\pm$ 5.93
Isoleucine	189.95 $\pm$ 10.22	182.90 $\pm$ 11.20	178.92 $\pm$ 9.47	161.86 $\pm$ 10.22
Lysine	1004.48 $\pm$ 54.52	812.92 $\pm$ 59.73	925.44 $\pm$ 50.48	901.75 $\pm$ 54.52
Leucine	367.34 $\pm$ 18.90	321.60 $\pm$ 20.70	326.98 $\pm$ 17.50	306.65 $\pm$ 18.90
Methionine	67.40 $\pm$ 6.39	67.04 $\pm$ 7.00	78.86 $\pm$ 5.91	67.90 $\pm$ 6.39
Threonine	448.44 $\pm$ 24.50	415.60 $\pm$ 26.83	394.53 $\pm$ 22.68	379.12 $\pm$ 24.50
Valine	404.34 $\pm$ 19.06	355.08 $\pm$ 20.88	360.94 $\pm$ 17.64	331.93 $\pm$ 19.06

Mean values with their standard errors, $n=6$ (CON), $n=7$ (CONT, CAF and CAFT).

CON, control chow diet; CONT, control chow diet supplemented with taurine; CAF, cafeteria diet; CAFT, cafeteria diet supplemented with taurine.

Table 2. Plasma amino acid concentrations of non-essential amino acids in adult male offspring

Male offspring, Non-essential Amino acids ($\mu\text{mol/L}$)	CON	CONT	CAF	CAFT
Alanine	934.02 $\pm$ 59.26	793.26 $\pm$ 64.91	887.20 $\pm$ 54.86	880.37 $\pm$ 59.26
Asparagine	94.05 $\pm$ 10.10	88.88 $\pm$ 11.07	83.44 $\pm$ 9.35	88.80 $\pm$ 10.10
Aspartic acid	1400.67 $\pm$ 93.34	1334.18 $\pm$ 102.24	1381.17 $\pm$ 86.41	1517.88 $\pm$ 93.34
Glycine	977.90 $\pm$ 48.83	962.20 $\pm$ 53.49	806.18 $\pm$ 45.21	883.65 $\pm$ 48.83
Glutamic acid	259.24 $\pm$ 34.34	221.98 $\pm$ 37.62	287.81 $\pm$ 31.80	278.37 $\pm$ 34.34
Glutamine	236.28 $\pm$ 32.86	211.77 $\pm$ 36.00	190.99 $\pm$ 30.42	194.75 $\pm$ 35.99
Ornithine	198.64 $\pm$ 37.38	212.78 $\pm$ 40.94	212.92 $\pm$ 34.60	183.87 $\pm$ 37.38
Proline	237.73 $\pm$ 10.96	223.74 $\pm$ 12.01	210.47 $\pm$ 10.15	218.48 $\pm$ 10.96
Serine	631.11 $\pm$ 30.86	558.63 $\pm$ 33.80	543.23 $\pm$ 28.57	593.38 $\pm$ 30.86
Cystine	21.68 $\pm$ 9.25	12.65 $\pm$ 9.25	32.90 $\pm$ 8.45	23.74 $\pm$ 8.45
Tyrosine	142.20 $\pm$ 6.95	122.14 $\pm$ 7.61	135.46 $\pm$ 6.43	147.38 $\pm$ 6.95
Tryptophan	150.76 $\pm$ 14.69	148.66 $\pm$ 16.09	131.62 $\pm$ 14.69	143.01 $\pm$ 14.69
Cystathionine	41.85 $\pm$ 9.27	23.15 $\pm$ 10.70	41.63 $\pm$ 10.70	34.36 $\pm$ 9.27

Mean values with their standard errors, $n=6$ (CON), $n=7$ (CONT, CAF and CAFT).

CON, control chow diet; CONT, control chow diet supplemented with taurine; CAF, cafeteria diet; CAFT, cafeteria diet supplemented with taurine.

The concentrations of plasma non-essential amino acids in adult male offspring is presented in Table 2. Similar pattern to the concentration of essential amino acids was observed in non-essential amino acids. Plasma alanine, asparagine, aspartic acid, glycine, glutamine, proline, serine, tryptophan and cystathionine levels exhibited lower concentrations in CONT, CAF and

CAFT when compared to CON but the effect of maternal diet and taurine did not exert any significant influence on plasma amino acid concentrations of non-essential amino acids in adult male offspring ($P>0.05$).

The plasma amino acid concentrations of essential amino acids in adult female offspring is presented in Table 3. Once again, plasma isoleucine, methionine, threonine and valine levels were seemed to be lower in CONT, CAF and CAFT when compared to CON despite nonsignificant effects of maternal diet and taurine ($P>0.05$). The concentrations of plasma non-essential amino acids in adult female offspring is presented in Table 4. Similarly, neither maternal diet nor taurine did not exert a significant effect on plasma non-essential amino acids in adult female offspring ($P>0.05$).

Table 3. Plasma amino acid concentrations of essential amino acids in adult female offspring

Female offspring, Essential Amino acids ($\mu\text{mol/L}$)	CON	CONT	CAF	CAFT
Phenylalanine	730.46 $\pm$ 43.03	755.00 $\pm$ 37.26	701.21 $\pm$ 39.84	725.72 $\pm$ 39.84
Histidine	108.89 $\pm$ 5.93	105.06 $\pm$ 5.14	110.73 $\pm$ 5.49	113.95 $\pm$ 5.49
Isoleucine	177.43 $\pm$ 10.22	165.90 $\pm$ 8.85	158.35 $\pm$ 9.45	161.74 $\pm$ 9.45
Lysine	949.40 $\pm$ 54.52	990.60 $\pm$ 47.22	949.22 $\pm$ 50.48	1034.09 $\pm$ 50.48
Leucine	300.30 $\pm$ 18.90	305.13 $\pm$ 16.37	274.98 $\pm$ 17.50	291.53 $\pm$ 17.50
Methionine	59.17 $\pm$ 6.39	46.32 $\pm$ 5.53	50.78 $\pm$ 5.91	58.95 $\pm$ 5.91
Threonine	407.54 $\pm$ 24.50	354.94 $\pm$ 21.21	403.28 $\pm$ 22.68	375.15 $\pm$ 22.68
Valine	325.24 $\pm$ 19.06	314.29 $\pm$ 16.51	295.72 $\pm$ 17.64	309.06 $\pm$ 17.64

Mean values with their standard errors, $n=6$ (CON), $n=7$ (CONT, CAF and CAFT).

CON, control chow diet; CONT, control chow diet supplemented with taurine; CAF, cafeteria diet; CAFT, cafeteria diet supplemented with taurine.

Table 4. Plasma amino acid concentrations of non-essential amino acids in adult female offspring

Female offspring, Non- Essential Amino acids ($\mu\text{mol/L}$)	CON	CONT	CAF	CAFT
Alanine	681.26 $\pm$ 59.26	610.10 $\pm$ 51.32	778.46 $\pm$ 54.86	697.54 $\pm$ 54.86
Asparagine	104.68 $\pm$ 10.10	67.33 $\pm$ 8.75	81.52 $\pm$ 9.35	76.34 $\pm$ 9.35
Aspartic acid	1228.95 $\pm$ 93.34	1378.74 $\pm$ 80.83	1430.78 $\pm$ 86.41	1267.70 $\pm$ 86.41
Glycine	533.54 $\pm$ 48.83	474.82 $\pm$ 42.29	466.71 $\pm$ 45.21	548.46 $\pm$ 45.21
Glutamic acid	204.11 $\pm$ 34.34	192.89 $\pm$ 29.74	145.44 $\pm$ 31.80	188.90 $\pm$ 31.80
Glutamine	264.92 $\pm$ 32.86	254.34 $\pm$ 28.45	247.43 $\pm$ 30.42	274.46 $\pm$ 30.42
Ornithine	233.39 $\pm$ 37.38	116.78 $\pm$ 32.37	146.43 $\pm$ 34.60	163.95 $\pm$ 34.60
Proline	196.47 $\pm$ 10.96	173.75 $\pm$ 9.49	204.15 $\pm$ 10.15	208.21 $\pm$ 10.15
Serine	467.79 $\pm$ 30.86	434.61 $\pm$ 26.72	460.25 $\pm$ 28.57	484.11 $\pm$ 28.57
Cystine	37.46 $\pm$ 8.45	31.63 $\pm$ 8.45	18.36 $\pm$ 9.25	28.12 $\pm$ 9.25
Tyrosine	110.39 $\pm$ 6.95	104.70 $\pm$ 6.02	114.40 $\pm$ 6.43	111.43 $\pm$ 6.43
Tryptophan	154.37 $\pm$ 14.69	159.60 $\pm$ 12.72	137.90 $\pm$ 13.60	141.16 $\pm$ 13.60
Cystathionine	39.60 $\pm$ 10.70	41.20 $\pm$ 8.29	49.81 $\pm$ 7.57	69.62 $\pm$ 9.27

Mean values with their standard errors, $n=6$ (CON), $n=7$ (CONT, CAF and CAFT).

CON, control chow diet; CONT, control chow diet supplemented with taurine; CAF, cafeteria diet; CAFT, cafeteria diet supplemented with taurine.

DISCUSSION

A cafeteria diet, characterized by high fat and energy content, can significantly impact plasma amino acid profiles. This diet induces obesity and insulin resistance, which in turn hampers glucose utilization and limits amino acid oxidation for energy (16). Plasma free amino acid profile is sensitive to dietary conditions, and high-protein meals can significantly alter concentrations even hours after ingestion (17). This can result in altered plasma amino acid levels. However, how the mentioned interactions occur in pregnancy metabolism has not been examined in detail in previous studies. As these changes are crucial for understanding the metabolic impacts of dietary patterns and their implications for future health, this study provided useful information about the possible effects of maternal cafeteria diet on plasma amino acid concentration of male and female offspring. Although current study showed no significant effects of maternal cafeteria diet on plasma amino acid concentration offspring, it is well-known that the effects of maternal diet on the plasma markers of offspring are multifaceted and depend on the specific nutrients and dietary compositions provided during gestation and lactation.

Interestingly, although most differences were not statistically significant, several essential and non-essential amino acids tended to show lower concentrations not only in the CAF and CAFT groups but also in the CONT group compared with the CON group. Because a similar trend was also observed in the taurine-supplemented control group, these findings cannot be attributed solely to maternal cafeteria diet exposure. Given that plasma amino acid concentrations are tightly regulated by metabolic homeostasis and are influenced by multiple physiological and dietary factors (17), this pattern may reflect normal biological variation rather than a specific dietary effect. Although no significant differences were observed, a subtle influence of taurine supplementation on amino acid metabolism cannot be completely excluded. However, these findings should be interpreted with caution, and further studies are warranted to clarify their biological significance.

The cafeteria diet significantly impacts protein intake and metabolism in rats, primarily through alterations in amino acid metabolism, insulin signalling, and gene expression related to protein and energy metabolism. These changes contribute to inefficient protein utilization, stable protein synthesis rates in key tissues, and disrupted metabolic responses, leading to increased adiposity and metabolic risk. Our previous study indicated that the protein intake of rats was significantly lower in cafeteria diet fed animals (14). Indeed, the maternal protein intake of CAF and CAFT animals was significantly lower as reported, previously (18). Even the taurine

supplementation (1.5% taurine in drinking water) did not induce a higher or similar protein intake in comparison to control animals. This can be explained by the rigorously higher intake of fat in cafeteria diet fed animals. Cafeteria diet applications do not have a standardized protocol and may differ from one study to another. Hence, in few studies cafeteria diets consisted of junk foods may lead to higher protein intake when compared to chow diet (19, 20). In one study, despite high protein and energy intake, rats on a cafeteria diet exhibit lower urea excretion which could be an indicator of an inefficient protein utilization (21). Inefficient protein utilization may lead to alterations in the expression of genes related to nutrient transport and metabolism in offspring. For instance, increased expression of nutrient-responsive receptors and transporters in the intestines of offspring suggests an adaptive response to inefficient nutrient utilization in a different study (22). This adaptive response could be the main reason of non-responsive plasma amino acid levels in the current study as offspring may develop an adaptive response to altered maternal dietary composition in CAF and CAFT animals and protect similar levels of amino acids during the post-weaning period.

Adechian et al., reported that chronic excessive energy intake from a cafeteria diet does not significantly alter protein synthesis rates in the liver and muscle, despite increased adiposity and energy intake (23). They concluded that in the absence of other metabolic alterations, chronic excessive energy intake and increased adiposity do not stimulate fed-state tissue protein synthesis rates and amino acid utilization. This suggests that protein synthesis in some tissues remains stable under such dietary conditions. This could be another reason for the non-responsive plasma amino acid levels in CAF and CAFT offspring. In fact, muscle tissue rather than plasma could be one of the most important focusing point in terms of modified maternal protein intake. Maternal low-protein diets during gestation and lactation result in long-term metabolic disorders in offspring, including reduced muscle mass and impaired glucose and protein metabolism (24, 25). This is linked to downregulation of the Akt-mTOR pathway, crucial for protein synthesis and muscle growth. Offspring from mothers on a cafeteria diet show reduced muscle cross-sectional area and fewer muscle fibers, indicating impaired muscle development and protein metabolism (24). Although the plasma amino acid levels did not change in the current study, the parameters related with protein synthesis in offspring muscle and muscle development are not known. Therefore, future studies should investigate these parameters to better understand the long-term effects of maternal cafeteria diet on offspring protein metabolism and muscle development.

Maternal taurine supplementation has been studied for its potential to mitigate adverse effects on offspring health caused by various maternal conditions such as obesity, dyslipidaemia, and undernutrition. The findings from multiple studies suggest that taurine can have significant, albeit sometimes sex-specific, benefits on offspring growth, metabolism, and overall health. In contradistinction to our results, taurine supplementation has been shown to influence amino acid levels in both maternal and offspring plasma. In a study examining the effects of maternal dietary supplementation with n-3 long-chain polyunsaturated fatty acids, taurine levels in maternal and cord plasma were significantly altered, suggesting that taurine supplementation can modulate amino acid profiles (26). Additionally, taurine is crucial for fetal development, particularly for the pancreas and brain (27). Its availability during fetal life is essential for normal beta-cell development and insulin action, which can have long-term effects on glucose metabolism and the risk of type 2 diabetes in adulthood. In our previous study, maternal plasma taurine levels were examined and results indicated that maternal plasma taurine was increased in CONT compared to CON, CAF and CAFT (18). Also, taurine was significantly lower in CAF than CON, CONT and CAFT. When the dietary intakes of mothers were investigated, it appeared that the estimated taurine consumption was significantly lower in CAFT than CONT. All of these data indicated that due to loaded energy and nutrient (especially fat) content of cafeteria diet, rats limited their water intake and thus taurine intake in CAFT group. Moreover, the expected results of this situation are reflected in plasma taurine levels of the mothers. Although current study did not indicate altered levels of plasma amino acids in adult offspring, the plasma taurine levels is unknown and this is considered as a limitation. Therefore, future studies will continue to concentrate on how the taurine levels would change along with plasma amino acids.

A study evaluating the effects of a maternal cafeteria diet on the plasma amino acid profile of offspring at the end of lactation indicated that exposure to a maternal cafeteria diet led to amino acid imbalance (28). Increases in plasma alanine, isoleucine, proline, serine, and glycine levels, and decreases in methionine, phenylalanine, and threonine levels were found in male and female offspring in the cafeteria group. In particular, the increase in gluconeogenic amino acid levels is thought to be an indicator of increased hepatic gluconeogenesis. It has also been reported that high alanine levels may be an indicator of hepatic insulin resistance. Current study showed that maternal cafeteria diet and taurine supplementation did not cause any significant differences in the plasma amino acid profiles of adult male and female rats. Adult male and female offspring were fed normal rat chow for 17 weeks after weaning, and protein intakes of

the groups were observed to be similar (10). Inevitably, it was found that the plasma amino acid concentrations of the groups were also similar. A study conducted by Choi et al., reported that taurine supplementation did not cause any characteristic changes in the plasma aminogram pattern, body weight gain, and food intake (29). Therefore, switching to a chow diet during post-weaning period and relatively older age of offspring at the time of amino acid examination may have also contributed to null results in the current study.

In conclusion, maternal diet plays a crucial role in shaping the plasma amino acid profiles of offspring, which in turn affects their growth, metabolism, and health. Although current study did not show any significant effects on plasma amino acid concentrations of offspring exposed to maternal cafeteria diet and/or taurine supplementation, specific amino acids like cysteine, serine, and branched-chain amino acids, as well as the overall quality and composition of maternal protein intake, may have significant impacts on the offspring's amino acid metabolism and physiological outcomes. Future studies will continue to focus on other parameters of protein metabolism and tissues like muscle mass to further examine the influence of modified maternal diets. These findings underscore the importance of balanced and adequate maternal nutrition during pregnancy and lactation for optimal offspring development.

Ethics approval: *All experimental procedures were approved by the Institutional Ethics Committee of Hacettepe University, Ankara, Türkiye (2015/01).*

Acknowledgements: *This study was funded by the Scientific and Technological Research Council of Turkey (No.115S538) and Scientific Research Projects Coordination Unit of Hacettepe University (No.TDK-2019-17813).*

Data availability: *Data will be made available on request.*

Conflict of interest: *The authors declare that they have no known competing financial interests or personal relationships that could influence the work reported in this study.*

Author contributions: *Study design: AA; Data collection: AKÇ; Data analysis: AKÇ, AG; Draft preparation: AA, AKÇ; Critical review for content: AA; Final approval of the version to be published: AA, AKÇ, AG.*

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