



Evaluation of Six Industry Diets on the Reproductive Success of DBA-2 Mice

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ABSTRACT

This study expands on previous findings that evaluation of 3 types of rodent feed showed no distinction of effect on the breeding success of C57BL/6 mice. Here, we used a more poorly breeding strain of DBA-2 mice and expanded the possible dietary strategies to 6 options. Six breeder pairs each were maintained on: 1) a standard control diet; 2) a commercial breeding diet with increased fat; 3) a supplement given 3 times weekly; 4) sunflower seeds given 3 times weekly; 5) supplemental gel cups given 3 times weekly; or 6) a pre-market total replacement diet. No dietary effect on breeding was demonstrated. There were significant decreases in the cannibalization of pups by dams supplemented with sunflower seeds or Diet Gel and those fed Omega 5BCE. Breeders provided with Diet Gel had significantly increased body weights. Fatty lipid profiles of each diet were analyzed, identifying the dietary fats used in these diets for a more specific understanding of the role they play in the mouse life cycle from conception, fetal development, lactation, and maintenance of weight gain. This study will be of interest to veterinarians and technicians who manage fragile breeding colonies.

MATERIALS & METHODS

36 male and female DBA-2 mice were ordered from Charles River at 2 months of age. Upon arrival, they were housed three to a cage with same gender and acclimated for two weeks on their study diet. Then six breeding pairs each were continuously housed and maintained on their assigned diet strategy until being euthanized.

According to their groups, mice were either fed: 1) ad lib in-house standard diet (Teklad 2018) as a control, 2) ad lib increased fat diet (Teklad 2019), 3) 5 g (+/- 0.2 g) Love Mash S3823P (Bio-Serv) given M,W,F in addition to ad lib standard diet, 4) 10 sunflower seeds scattered about the cage M,W,F, in addition to ad lib standard diet, 5) 76A Diet Gel cups (H2O) given M,W,F in addition to ad lib standard diet, or 6) Total Replacement Test Diet 5BCE by Agricultural Omega Solutions.

Cages were stocked with pelleted paper bedding (Harlan 7084), one facial tissue for nesting, and bottled acidified R/O water. They were housed on a ventilated rack (Lab Products), on a 12 hour light cycle. Groups were arranged in columns so that light levels of cages was similar for each.

Water bottles and cage bottoms were changed every other week and the wire hoppers were changed monthly. Lab staff performed all feeding, cage changing, and animal handling to minimize stress on breeders. At time of cage change, adults were also weighed. Cages were checked daily for food, water, health, and new litters.

IU School of Medicine LARC is an AAALAC accredited institution and all procedures were done according to an IACUC-approved protocol. At the end of study, breeders were fasted overnight; processing included CBC, Chem, and organ weights. Analysis of gut contents from female breeders was conducted.

RESULTS

Breeder Production Index: To calculate BPI, we divided the total number of pups produced by each female by the number of days that she was bred (paired to last weaning or birth of last cannibalized litter). Each group was compared to the 2018 (control), and no significant differences were found in dietary strategy.

Cannibalism: For cannibalism rates, we divided the number of litters lost/cannibalized by the total number of litters produced for each female. We compared each group to the 2018 (control). Three strategies showed significant decreases in cannibalism: Sunflower seeds (p = 0.0067), Diet Gel (p = 0.0186), and 5BCE (p = <0.0001).

Body Weight: Breeders fed the Diet Gel supplement were found to have significantly higher body weights during final processing (p = 0.0005 for males and 0.0023 for females). In the 5BCE group, male breeders had significantly lower body weights (p = 0.0103).

CBC: At necropsy, male breeders fed 2019 diet were found to have decreased MCV (p = 0.0012). Female breeders supplemented with Diet Gel were found to have decreased lymphocytes (p = 0.0283) with no corresponding change in neutrophils. 5BCE-fed female breeders had elevated MCH & MCV (p = 0.0242 & 0.0089, respectively) and a decrease in platelets (p = 0.0223).

Organ Weights: Female breeders on 5BCE diet had significantly higher % liver weights (p = <0.0001) and fasting blood glucose (p = 0.0201), and a decrease in % heart weight (p = 0.0331). Diet Gel supplemented female breeders had a decrease in % liver weight (p = 0.0004). Females on 2019 diet had elevated % kidney weights (p = 0.0441). Those supplemented with Love Mash had lower fasting blood glucose p = 0.0485).

Male breeders fed 5BCE diet were found to have significant increase in % liver (p = 0.0042) and % kidney weights (0.0196). Those supplemented with Love Mash had decrease in % spleen weight (p = 0.0452).

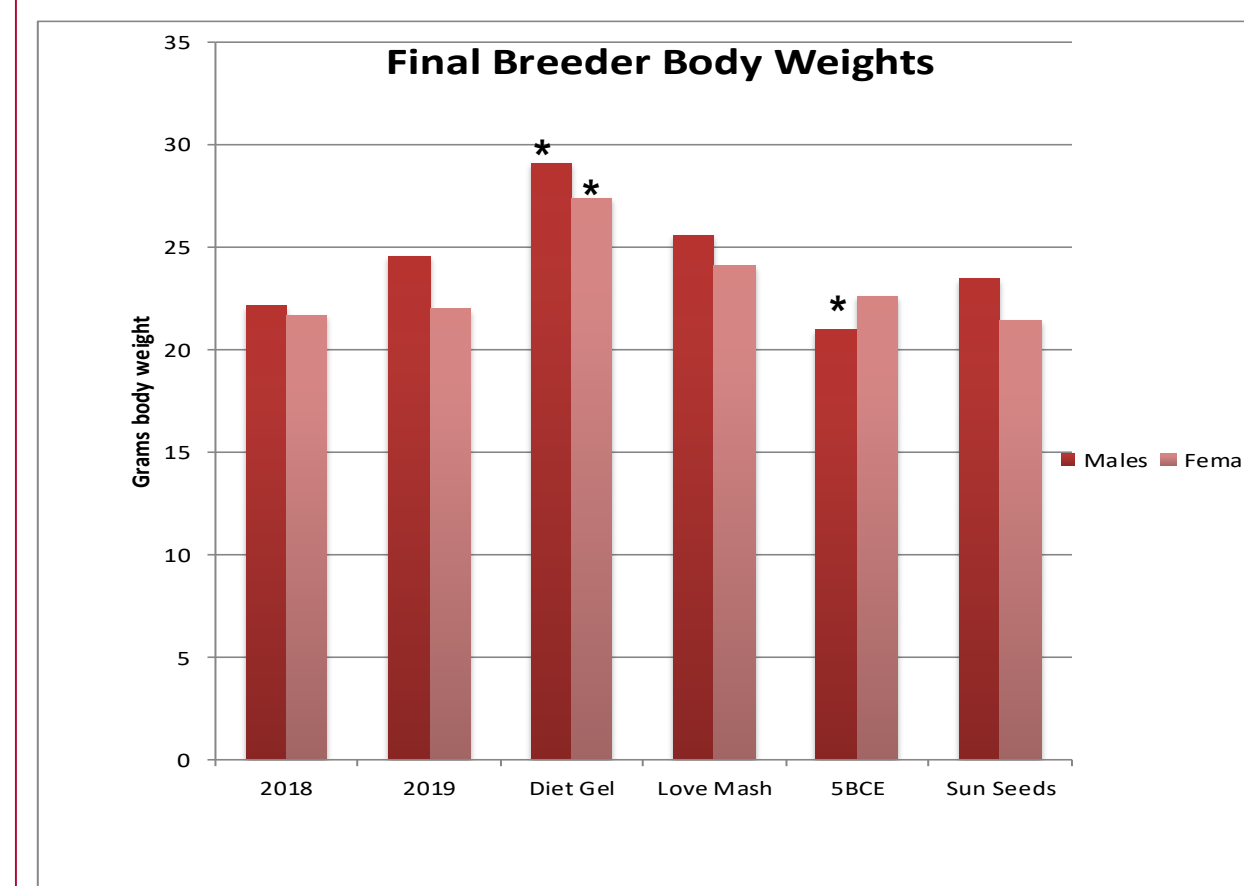
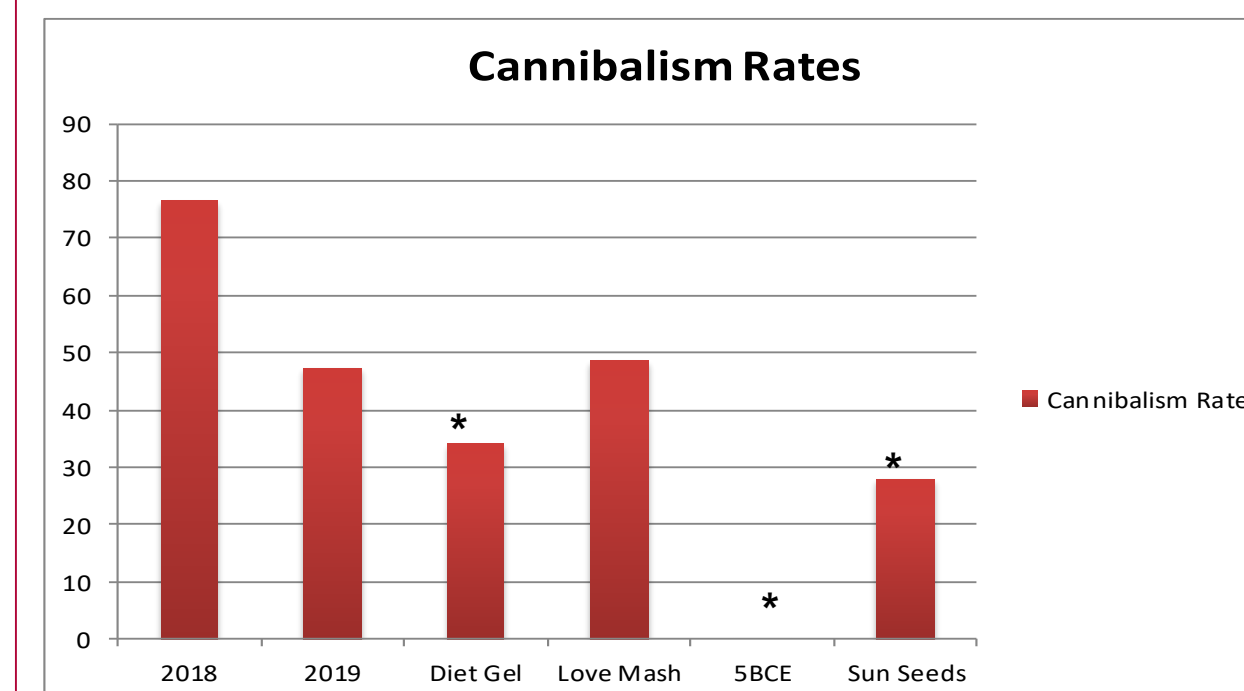
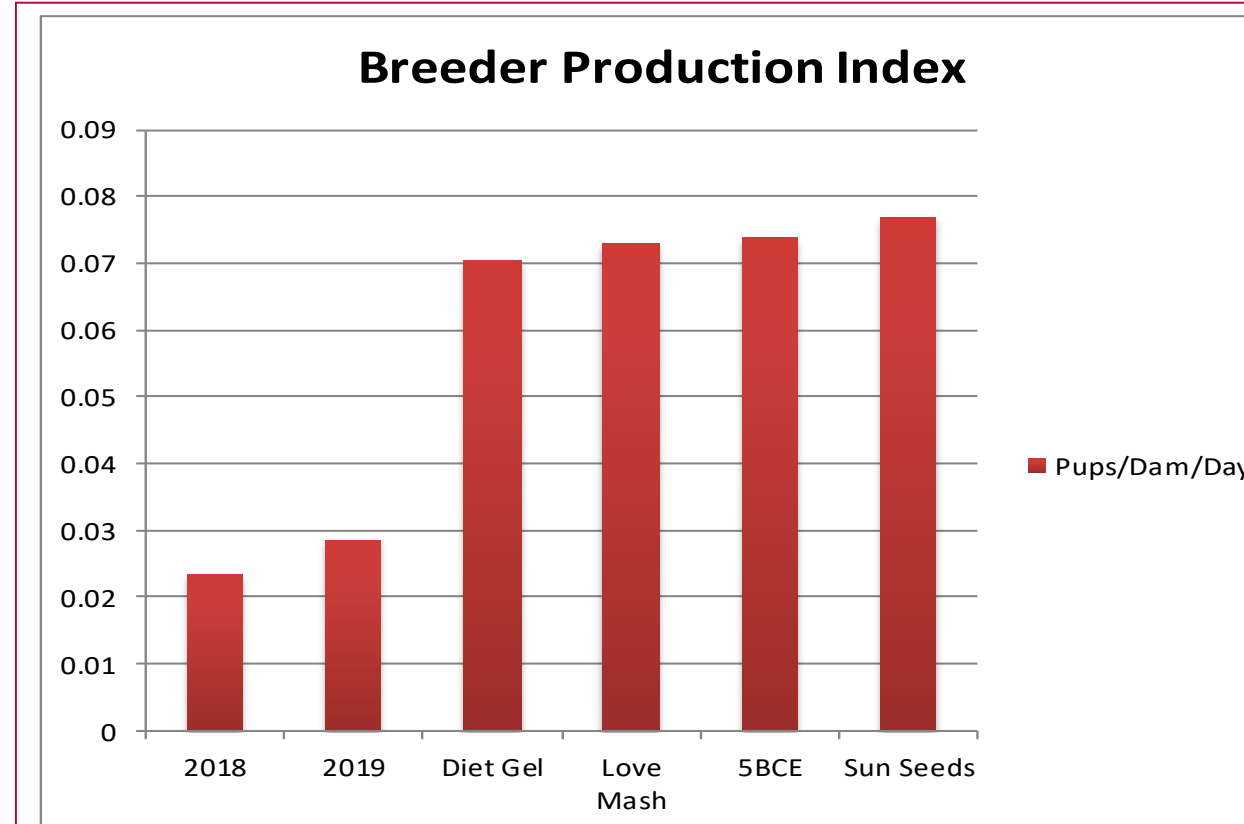
Female weanlings (culled at 21 days) were found to have significant increases in % liver weight in the 2019 (p = 0.0005), Diet Gel (p = 0.0044), and sunflower Seeds (p = 0.0428) groups. In the Love Mash raised cages, female weanlings had an increase in % liver weight (p = <0.0001). Male weanlings from the 5BCE group were found to have a decrease in % spleen weight (p = 0.0077) with an increase in % liver weight (p = 0.0028).

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RESULTS GRAPHS



DISCUSSION

Per Charles River, DBA/2 mice are known to be poor breeders, averaging 3 pups from the first litter, and four pups for the second. Although no significant differences between dietary strategies was demonstrated in this study, BPI did show increases, especially in the Diet Gel, Love Mash, 5BCE, and Sunflower Seed groups.

Cannibalism rates were significantly lowered in the Diet Gel, 5BCE, and Sunflower Seed groups. These diets provided floor feeding, which likely serves as both foraging enrichment and an easier way for dams and pups to eat. Though 5BCE is a total replacement provided in the hopper, it is a crumbly food that converts to a lot of floor feeding. Despite this, it did not seem that we had to refill the 5BCE more often than the other diets, leading us to believe that, indeed, mice preferred to forage from the cage floor.

The notable exception to this theory would be that Love Mash is a foraging supplement but did not significantly reduce rates of cannibalism. Since all trace of Love Mash (and Sunflower Seeds) were consumed before the next feeding, it is possible that the provision of foraging is more important than strictly the dietary formula of the provided food, in which case, Love Mash benefits may be demonstrated if feed rates were increased to provide longer duration of foraging opportunities. Bio-Serv's directions for Love Mash are to provide 2 pellets every other day, but because we found pellet size to vary greatly, we normalized it to 5g (+/- 0.2 g) in this study.

A "hands off" approach to mouse cages with new litters is generally recommended, especially in poorly breeding strains. Therefore, we expected to see an increase in cannibalism rates in the groups that were accessed three times every week; however, this did not seem to be the case.

Diet Gel was ingested in varying degrees, but it was a much larger volume of supplemental diet than Love Mash and sunflower Seeds. The free access to this easily-consumed food likely explains the significant increase in body weight, but it did not appear to detrimentally effect breeder success.

On necropsy, one of the female breeders from the 2018 group was found to have hepato- and splenomegaly. Liver also contained large areas of abscess. Therefore, she was excluded from the CBC and organ weight data as extreme outlier.

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