 IMPACT OF USING CHAMOMILE FLOWER AS A FEED ADDITIVE ON REPRODUCTIVE PERFORMANCE AND PHYSIOLOGICAL RESPONSES OF FARAFRA EWES DURING HEAT STRESS CONDITIONS

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(Received 9/9/2018, accepted 21/10/2018)

SUMMARY

This work was carried out to investigate the effects of Chamomile flower supplementation as a feed additive on reproductive performance and physiological responses of ewes during heat stress conditions. Forty-five healthy fertile Farafra ewes aged 2.0-4.0 years with an average body weight of 42.1 ± 0.92 kg were equally divided into three groups (15 ewes each), control group: received basal diet with no additives, T1: received basal diet + 0.5 gm chamomile flower /10 kg L.B.W/ day and T2: received basal diet + 1.0 gm chamomile flower /10 kg L.B.W/ day. The experiment lasted through a season of mating till parturition during the summer season. Body weight of ewes was improved at the end of pregnancy and after lambing in both supplemented groups (T1 & T2) compared to the control group. Concerning reproductive performance, the number of ewes exhibited estrus in Chamomile supplemented groups (T1, T2) was higher than those in the control group. Also, supplemented ewes exhibited estrus earlier than control ones, especially in T2. Conception rate was improved by Chamomile supplementation, it was 93.3% in T2 followed by 80.0% in T1 and the lowest one was in the control group (73.3%). Also, the numbers of total and alive lambs born were higher in supplemented groups compared to control. In addition, Chamomile supplementation increased birth weight of lambs, this increase was significant (P<0.05) between T2 versus control (4.02 vs. 3.32 kg) however, it was not significant between T1 and control. Rectal and skin temperatures values were lower in both Chamomile supplemented groups compared to control. At the same time, respiration rate was decreased significantly in treated groups (32.5 in T1 and 32.8 in T2) than the control group (40.6). However, opposite trend of results was obtained in gas volume/minute and tidal volume. Metabolic rate (MR) and heat production (HP) were significantly (P<0.05) higher in T2 compared to both T1 and control groups. Serum total protein, albumin, and globulin tended to insignificantly increase with chamomile supplementation. In addition, serum urea, creatinine, AST and ALT concentrations did not significantly differ among groups and all values of these investigated blood metabolites were within the normal range of sheep. In conclusion, supplementation of chamomile flowers as a herbal feed additive had a beneficial effect on reproductive performance of ewes and the better improvement was observed with the high level of supplementation (1.0 gm chamomile flower /10 kg L.B.W/ day). Moreover, the investigated physiological responses during heat stress were improved by the supplementation with no adverse side effects on blood metabolites.

Keywords: Chamomile, feed additive, reproductive performance, physiological responses, heat stress.

INTRODUCTION

Small ruminants play a pivotal valuable role in socio-economic status of millions of small farmers, about 90% of small ruminant “sheep and goats” are owned by rural households (Ministry of Agriculture and Land Reclamation, 2015), which are characterized by poverty, poor feeding and housing facilities, lack of modern management skills, inappropriate breeding practices and inadequate adoption of technologies, which are essential to improve the productivity. In addition to the previous obstacles that face small ruminants production in our environment, heat stress appears as a major problem added to the previous ones. It was well proven that heat stress had strong bad effects on animal productive and reproductive performances, in terms of decreasing body weight gain and milk production, lowering fertility and conception rate and causing embryonic mortality, besides many adverse effects on physiological responses (Dash et al., 2016).
Medicinal herbs and plants have been widely used for human since the old civilizations, especially ancient Egypt, and over the last five decades, there has been an increasing interest in the utilization of herbs and medicinal plants in animal nutrition as an effective and safe substitutions of chemical substances (antibiotics and hormones, etc.). Some substances found in these plants and herbs had prophylactic and therapeutic effects (Linde et al., 2001). Many investigations confirmed a beneficial impact of medicinal herbs and plants on nutrients digestibility, feed efficiency and productive performance of small and large ruminants (Maged 2004, Shehata et al. 2007 and Shwereb, 2012).

Chamomile (Matricaria chamomilla L.) belongs to a large group of medicinal plants, it contains a great number of therapeutically interesting active compounds such as sesquiterpenes, flavonoids, coumarins, and polyacetylenes, which have antiphlogistic and antiseptic effects (Singh, et al., 2011). It has been reported that dietary Chamomile improved milk yield and composition (Shehata et al. 2004), improved ruminal environment and increased digestion coefficients (Maged 2004), reducing the incidence of digestive problems such as bloating and diarrhea and minimizing the mortality rate of the offspring (El-Hosseiny et al., 2000 & Shehata et al. 2007), besides the improvement that happened to some blood constituents such as (Cholesterol, ALT, AST and Alkaline Phosphatase) (Maged 2004, and 2011). Furthermore, it enhances immunity and prevent from aflatoxin effect (Tawfik et al. 2005). This beneficial effects of Chamomile might be referred to that it contained some active substances such as flavonoids, coumarins, aromatic oils (alpha bisabolol, azulene and chamazulene), which act as tonics, antiseptic, stomach pain release, anti-inflammatory and antispasmodic agents (Ody, 1993). In addition, Sepide and Alesaeidi, (2016) reported that Chamomile contained substances have an antioxidant and antibacterial activity. Antioxidants supplementation protect the body defense system against excessively produced free radicals during heat stress and stabilize the health status of the animal could ameliorate the bad effect of heat stress (Sivakumar et al., 2010). Therefore, we attempted in this study to investigate the effects of Chamomile supplementation as a feed additive on reproductive performance and physiological responses of ewes during heat stress conditions.

MATERIALS AND METHODS

This study was conducted in Mallawi Animal Production Research Station (Mallawi city, Minia Governorate, which lies between longitudes 27 ° 43 ’ N, latitudes 30 ° 50 ’ E and 52 meters above sea level), Agriculture Research Center, Cairo, Egypt. Forty five healthy fertile Farafra ewes were included in this investigation, aged 2.0-4.0 years with an average body weight of 42.1 ± 0.92 kg. The study was carried out during summer season and lasted 6 months (from May to October 2016), along of mating and pregnancy seasons till parturition.

Ewes were divided homogenizely according to their age, parity and initial body weight into three equal groups (15 ewes per group). The three groups were fed as follow:

Control: Fed basal diet.

Treatment 1 (T1): Fed basal diet + 0.5 gm chamomile flower /10 kg L.B.W/ day.

Treatment 2 (T2): Fed basal diet + 1.0 gm chamomile flower /10 kg L.B.W/ day.

Animals were fed in groups according to NRC (1985). Ewes were weighted biweekly and feed amounts were adjusted according to their body weight changes. For the first month, ewes were fed on the experimented rations as acclimation period. Table (1) showed the chemical analyses of the used feedstuffs (concentrate feed mixture and rice straw).

| Item                                | DM  | OM  | CP  | CF  | EE  | NFE | Ash |
|-------------------------------------|-----|-----|-----|-----|-----|-----|-----|
| Concentrate feed mixture (CFM)      | 93.7| 88.0| 13.8|15.2 | 3.6 | 55.4| 12  |
| Rice straw                          | 90.9| 84.1| 4.0 |33.4 | 1.6 | 45.1|15.9|

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Measurements and procedures:

Reproductive performance:

A teaser ram was used for estrus detection of ewes three times daily for 35 days and fertile rams were used to breed ewes that presented estrus twice daily (at the beginning of estrus and after 12 hrs. later). Estrus duration (hrs.) and number of service per conception were recorded. Also, conception rate (%) was calculated by the number of parturated ewes divided by the total joined ewes. In addition, number of lambs born/ewe and birth weight recorded.

Thermal responses and respiratory activities:

Thermal responses in terms of rectal, skin and wool temperatures were taken and respiratory activities in terms of respiration rate and gas volume/minute was measured by Dry Gas Meters, tidal volume was calculated, O₂ consumption and CO₂ release were measured by oxygen analyzer (Servomex 570) then heat production (HP) and metabolic rate (MR) were calculated. All of these parameters were taken at 12:00 am. Ambient temperature and relative humidity were recorded.

Blood sampling and measurements:

Blood samples (5 ml) were taken from the jugular vein from each animal at morning before feeding and drinking. These samples were centrifuged at 3000 r.p.m. for 15 minutes. Separated serum was frozeed until the analyses of blood metabolites. Some blood metabolites including Total protein, albumin, AST, ALT, urea, createnine were determined using commercial kits by colorimetric method.

Statistical analysis

Statistical analysis was carried out using SPSS v. 20.0 for Windows (SPSS Inc., Chicago, IL). Data were analyzed by One way ANOVA. Duncan's New Multiple Range Test (Duncan, 1955) was used to test the differences among means. The following statistical model was used:

\[ Y_{ij} = \mu + T_i + E_{ij} \]

Where, \( Y_{ij} \) = The studied trait, \( \mu \) = The overall mean, \( T_i \) = The effect of treatment \( i = (T1, T2) \), \( E_{ij} \) = The experimental error.

RESULTS AND DISCUSSION

Body weight changes.

Results in Table (2) showed that average body weight of different groups of ewes at mating was almost the same, however, at the end of pregnancy, it was significantly higher in T2 compared to control (50.3 vs. 45.0 kg). After lambing, average body weight was significantly higher in both supplemented groups T1 & T2 (43.1 & 42.1 kg) compared to control (37.5 kg). It is well known that most of body weight increase during pregnancy refers to increasing fetal weight which also was improved by treatments (as we will see in

| Body weight (kg)                  | Control     | T1          | T2          |
|----------------------------------|-------------|-------------|-------------|
| At mating                        | 42.1 ± 0.94 | 41.9 ± 0.92 | 42.0 ± 0.89 |
| At the end of pregnancy          | 45.0± 1.48  | 48.8± 1.41  | 50.3± 1.67  |
| After lambing                    | 37.5± 1.32  | 42.1± 1.18  | 43.1± 1.38  |

Control: Fed basal diet, \( T_1 \): Control + 0.5 gm chamomile flower /10 kg L.B.W/ day, \( T_2 \): Control + 1.0 gm chamomile flower /10 kg L.B.W/ day.

Values with different superscript letters in the same row are significantly different, (P<0.05)
birth weight). Similar results were found in sheep by Zeid et al., (2011) and in goats by El-Hosseiny et al. (2000). This beneficial effect in body weight may be attributed to the improvement in digestibility and nutritive values due to Chamomile supplementation as a natural medicinal herb containing active ingredients, which act as an antiseptic against the antagonistic flora and stimulate the digestive enzymes and digestive processes. It has been reported that digestion coefficients of all nutrients and feeding values besides feed efficiency were improved with increasing the level of chamomile supplementation in sheep rations (Zeid et al., 2011 & El-Kholany et al., 2015 & 2017). Also, El-Ghousein, (2010) stated that chamomile supplementation improved the ruminal environment and increased digestion coefficients.

Reproductive performance.

Table (3) presents the results to study the effect of Chamomile supplementation on estrus exhibition and estrus period length. Generally, the number of ewes exhibited estrus in Chamomile supplemented groups (T1,T2) was higher than the control group. Also, supplemented ewes exhibited estrus earlier than control ones, especially in T2. This is beneficial because it will decrease number of services per conception for supplemented ewes. Similarly, Mirzaei et al., (2011) reported that using medicinal herbs as a feed additive in sheep and goats nutrition enhanced estrus cyclicity. Also, Barhane and Singh (2002) reported that supplementation of Chamomile postpartum led to 100% estrus and 75% conception in the supplemented group as compared to 50 % in control cows. In addition, Zangeneh et al., (2010) found that Chamomile can enhance estrus and help LH secretion “ovulation hormone” in rats.

Table (3): Effect of Chamomile supplementation on estrus exhibition and estrus period length.

| Group | Ewes exhibited estrus / total | Estrus period length (hrs.) |
|-------|-----------------------------|-----------------------------|
|       | No. (%)                     | 12 to 24 hrs. | 24 to 36 hrs. | 36 to 48 hrs. | 48 hrs. and more. |
| Control | 13  | 86.7 | 3 | 20.0 | 6 | 40.0 | 3 | 20.0 | 1 | 6.7 |
| T1     | 14  | 93.3 | 3 | 20.0 | 9 | 60.0 | 2 | 13.3 | 0 | 0 |
| T2     | 14  | 93.3 | 4 | 26.7 | 10 | 66.7 | 0 | 0 | 0 | 0 |

Regarding the effect of Chamomile supplementation on some reproductive traits of ewes (Table. 4). As we expected, supplemented groups need a lower number of service/conception than control "this refers to the lower estrus period length in these supplemented groups". Conception rate (%) from total joined ewes was improved by Chamomile supplementation, it was (93.3%) in T2 followed by (80.0%) in T1 and the lower conception rate was in control group (73.3%). Also, the numbers of total and alive lambs born were higher in supplemented groups than control "it was more obvious in T2 than T1". Also, the results revealed that Chamomile supplementation increased birth weight, this increase was significant between T2 versus control (4.02 vs. 3.32 kg) however, it was not significant between T1 versus control "this result explains the obvious increase in body weight of ewes at the end of pregnancy".

Heat stress had major adverse effects on sheep reproduction, it led to increased maternal, fetal metabolism and increased reactive oxygen species production during gestation which consequently increased requirements for micronutrients, including antioxidants (Pedernera et al., 2010), and it is well known that antioxidant deficiency is strongly correlated with poor fertility and reproduction in ruminants (Nayyar and Jindal, 2010). Reynolds et al., (2010) reported that nutrient restriction during gestation which resulted from heat stress has a very bad effect on placental and fetal growth and development. Thus, the supplementation of feed additives that contains antioxidant substances such as Chamomile, which contains flavonoids, coumarins, aromatic oils, alpha bisabolol, azulene, and chamazulene that could alleviate the worse effect of heat stress and save fertility and reproduction.

Generally, our results revealed that Chamomile supplementation improved reproductive traits, that was evidenced by the improvement in conception rate and birth weight of produced lambs. These results agreed with those of El-Ghousein, (2010) on sheep, Mirzaei, (2011) on goats, they reported a significant improvement in reproductive performance as a result of Chamomile supplementation. Chamomile has antioxidant effect because it contains some ingredients that play as an antioxidant agents (Sepide and Alesaeidi, 2016). Our present results may be explained by the beneficial effect of Chamomile.
supplementation on the alleviation of heat stress and oxidative stress adverse effects, maintaining acid base balance and antioxidant status, and improving feed intake and nutrients digestibilities (Zeid et al., 2011, Sejian et al., 2014 and El-Kholany et al., 2015). Also, it improved immunity and detoxification of the aflatoxin (Tawfik et al. 2005).

Table (4): Effect of Chamomile supplementation on some reproductive traits of ewes.

| Item                                      | Control | T1       | T2       |
|-------------------------------------------|---------|----------|----------|
| No. of ewes/group                         | 15      | 15       | 15       |
| No. of service/conception                 | 2.15 ± 0.25 | 1.93 ± 0.17 | 1.71 ± 0.13 |
| No. of ewes lambed                        | 11      | 12       | 14       |
| Conception rate (%) from mated ewes       | 84.6    | 85.7     | 100      |
| Conception rate (%) from total joined ewes| 73.3    | 80       | 93.3     |
| No. of total lambs born                   | 12      | 14       | 16       |
| No. of alive lambs born                   | 11      | 14       | 16       |
| No. of total lambs produced/ewe lambed    | 1.09 ± 0.09 | 1.17 ± 0.11 | 1.14 ± 0.09 |
| No. of lambs produced (alive)/ewe lambed  | 1.00 ± 0.00 | 1.17 ± 0.11 | 1.14 ± 0.10 |
| Average birth weight (kg)                 | 3.32 b ± 0.22 | 3.69 ab ± 0.12 | 4.02 a ± 0.20 |
| Total birth weight/ewe (kg)               | 3.62 b ± 0.19 | 4.30 ab ± 0.32 | 4.58 a ± 0.26 |

Control: Fed basal diet, T1: Control + 0.5 gm chamomile flower /10 kg L.B.W/ day, T2: Control + 1.0 gm chamomile flower /10 kg L.B.W/ day. Values with different superscript letters in the same row are significantly different (P<0.05)

Thermal responses, respiratory activities and heat production measurements.

Results in Table (5) showed that means of rectal temperature were decreased significantly (P<0.05) in T2 compared to control group (39.23 vs. 39.75 C°), however it did not differ significantly between T1 and control. Skin temperature was significantly (p<0.05) lower in both supplemented groups (T1,T2) than control. While, wool temperature did not differed among groups. At the same time, respiration rate values were decreased significantly in treated groups (32.50 in T1 and 32.78 in T2) than control group (40.60), however, opposite trend of results were obtained in gas volume/minute (GV) and tidal volume (TV). Metabolic rate (MR) and heat production (HP) values were significantly higher in T2 compared to both T1 and control groups. However, metabolic rate and heat production values were insignificantly higher in T1 compared to control.

Table (5): Effect of Chamomile supplementation on thermal responses, respiratory activities and heat production measurements.

| Parameter                                | Control         | T1             | T2             |
|------------------------------------------|-----------------|----------------|----------------|
| Rectal temp. (RT) C°                     | 39.75 ± 0.11    | 39.48 ab ± 0.25 | 39.23 b ± 0.09 |
| Skin temp. (ST) C°                       | 35.78 ± 0.10    | 35.32 b ± 0.11  | 35.29 b ± 0.07 |
| Wool temp. (WT) C°                       | 33.48 ± 0.05    | 33.46 ± 0.08    | 33.34 b ± 0.08 |
| Respiration rate (breathe/minute)        | 40.6 ± 1.48     | 32.5 b ± 2.43   | 32.8 b ± 2.63  |
| Gas volume (L/minute)                    | 4.52 ± 0.54     | 4.70 ± 0.34     | 5.59 ± 0.56    |
| Tidal volume (ml/breathe)                | 110.03 b ± 11.18 | 147.72 a ± 9.15 | 172.09 ± 12.04 |
| Metabolic rate (Kcal/day)                | 69.93 b ± 9.27  | 80.89 b ± 8.30  | 121.71 ± 18.23 |
| Heat production (Kcal/day)               | 72.08 b ± 7.66  | 81.67 b ± 6.06  | 106.17 ± 10.74 |

Control: Fed basal diet, T1: Control + 0.5 gm chamomile flower /10 kg L.B.W/ day, T2: Control + 1.0 gm chamomile flower /10 kg L.B.W/ day. Values with different superscript letters in the same row are significantly different, (P<0.05)
As we mentioned above, the present experiment was carried out during summer under heat stress conditions in upper Egypt region, which negatively affect the animal performance. There are some physiological responses of the animal to heat stress, of these, increasing respiration rate, sweating, vasodilation with increased blood flow to the skin surface, high rectal temperature, besides the alteration of water metabolism, these responses are associated with negative impacts on production and reproduction, in addition, heat stress can cause ruminal changes due to larger physiological changes within the animal (Tajimaa et al., 2007). In our study, the lower respiration rate combined with high gas and tidal volumes, metabolic rate and heat production in Chamomile supplemented groups (T1,T2) revealed that these animals suffering less from heat stress and their physiological performance was improved or modulated compared to control group.

To our knowledge, very little data are available about the effect of Chamomile supplementation on gas exchange and heat production of farm animals. Our present results are in agreement with Watts, (2014) who reported that Chamomile addition to sheep diets alleviate the adverse effects of heat stress on the animal by improving the physiological and thermal responses. Chauhan et al., (2014) and Hayder et al., (2016) found that antioxidants supplementation during heat stress improves physiological responses of sheep in terms of RT, ST, RR, and HP, they explained this result by antioxidants supplementation with different doses improved the oxidative status and reduce the negative effects of heat stress. Furthermore, Sejian et al., (2014) reported that dietary antioxidant "by mineral addition" protected ewes against heat stress by decreasing rectal, skin temperature and respiration rate.

**Blood metabolites.**

Results of some blood metabolites of ewes fed the experimental rations are presented in Table (6). Serum total protein, albumin, and globulin tended to increase with Chamomile supplementation but differences among groups were not significant, higher values were recorded in T2 followed by T1 and the lowest values were found in control group. Also, A/G ratio showed slight insignificant changes. Serum urea and creatinine concentrations showed some fluctuations among groups with insignificant differences. The same trend of results was noticed in liver function tests, AST and ALT concentrations were not changed significantly by chamomile supplementation. In addition, all values of these investigated blood metabolites were within the normal range (Maged, 2011).

Our results were supported by the results of Zeid et al., (2011) on sheep, Maged, (2011) on goats and El-Kholany et al., (2015) in cows. They reported that serum total protein, albumin and globulin concentrations were slightly increased (improved) by chamomile supplementation. Also, liver and kidney function were not significantly changed by chamomile supplementation. In the present study, the slight improvement in total protein, albumin and globulin values in chamomile supplemented groups may be attributed to the improved nitrogen absorption and reflects no pathological disturbance in the liver, also, chamomile supplementation did not cause health disorders which was evidenced by normal kidney and liver function tests (Zeid et al., 2011).

**Table (6): Effect of Chamomile supplementation on some blood metabolites.**

| Parameter          | Control | T1      | T2      |
|--------------------|---------|---------|---------|
| Total protein (g/dl)| 6.65 ± 0.20 | 7.02 ± 0.15 | 7.03 ± 0.25 |
| Albumin (g/dl)     | 3.59 ± 0.16 | 3.83 ± 0.14 | 3.77 ± 0.14 |
| Globulin (g/dl)    | 3.06 ± 0.12 | 3.19 ± 0.11 | 3.26 ± 0.15 |
| A/G ratio          | 1.19 ± 0.08 | 1.21 ± 0.07 | 1.17 ± 0.05 |
| Urea (mg/dl)       | 33.8 ± 1.6 | 37.5 ± 1.7 | 37.7 ± 1.8 |
| Creatinine (mg/dl) | 1.16 ± 0.03 | 1.21 ± 0.03 | 1.19 ± 0.04 |
| AST, GOT (U/l)     | 36.9 ± 1.1 | 35.7 ± 1.2 | 38.9 ± 1.2 |
| ALT, GPT (U/l)     | 34.5 ± 1.0 | 33.4 ± 1.2 | 33.2 ± 1.3 |

Control: Fed basal diet, T1: Control + 0.5 gm chamomile flower /10 kg L.B.W/ day, T2: Control + 1.0 gm chamomile flower /10 kg L.B.W/ day.
Values with different superscript letters in the same row are significantly different, (P<0.05)
CONCLUSION

From the obtained results, it could be concluded that supplementation of chamomile flowers as a feed additive during heat stress had a beneficial effect on reproductive performance by improving conception rate of ewes and birth weight of their produced lambs. The better improvement was observed with the high level of supplementation (1.0 gm chamomile flower /10 kg L.B.W/ day). Moreover, thermal responses, respiratory activities and heat production measurements of animals during heat stress were improved by the supplementation with no worse side effects on blood parameters.

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تأثير استخدام زهرة الباوبونج (الكاميمل) كمادة غذائية على الأداء التناضلي والاستجابات الفسيولوجية للعلاج

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أجريت هذه الدراسة لتقديم تأثير استخدام زهرة الباوبونج (الكاميمل) كمادة غذائية على الأداء التناضلي والاستجابات الفسيولوجية للعلاج، القياسات التي قام بها فلاح العالم العربي وأحمد مصطفى وأحمد شلتوت وفتحي محمد وأحمد شلتوت وأحمد شلتوت. استخدمت هذه الدراسة عدد متنوع من مراحل الإجهاد البديلة وعقود متنوعة وحالة متنوعة، كانت المجموعة القياسية مكونة من مجموعات نصف كميات من زهرة الباوبونج (0.5 و/و 10 كم من وزن الجسم/يوم). استمرت التجربة خلال موسم قابل للاستعمال، وتم استخدام الاستجابات الفسيولوجية وعضا.

الخلاصة: أوضحت النتائج تحسن وزن الجسم للعلاج في كل من المجموعات الأولي والثانية في نهاية فترة الدراسة بعد الدراسة مقارنة بالمجموعة الضابطة. فيما يتعلق بالأداء التناضلي، فقد كان عدد النتائج أظهرت الشفافية في المجموعات المختلبة (الأولي والثانية، أعلى منها في المجموعة الضابطة. وقد أوضح النتائج تحسن معدل الجسم عند طريقة إضافة الباوبونج. فكان 93.8% في المجموعة الأولى بينما وجد أقل معدل للرجل في المجموعة الضابطة. 73.3% بالنسبة إلى ذلك، فقد ارتقى وزن البدلة للرجل الناتجة من مجموعات الباوبونج المختلبة. وأتى ذلك هذه الزيادة معينة بين المجموعات، زيادة المجموعة الضابطة (0.42٪) في حين أن هذه الزيادة لم تكن معينة بين المجموعات الأولى والثانية. فيما يتعلق بالاستجابات الفسيولوجية، فقد أظهرت كلا من درجة حرارة الجسم والبدلة في المجموعات المختلبة (0.5 و/و 10 كم من وزن الجسم/يوم) انخفاض معدل التجفيف بشكل معينى في المجموعة المختلبة (0.5 و/و 10 كم من وزن الجسم/يوم) وتغير ضعف بالمجموعة الضابطة. في نفس الوقت، فقد أظهرت كلا من درجة حرارة الجسم والبدلة في المجموعات المختلبة (0.5 و/و 10 كم من وزن الجسم/يوم) انخفاض معدل التجفيف بشكل معينى في المجموعة المختلبة (0.5 و/و 10 كم من وزن الجسم/يوم). في النهاية، أوضح النتائج تحسن وزن الجسم للعلاج في كل من المجموعات الأولي والثانية في نهاية فترة الدراسة بعد الدراسة مقارنة بالمجموعة الضابطة.