Fat Metabolism and Acute Resistance Exercise in Trained Men

Michael J. Ormsbee¹, John P. Thyfault³, Emily A. Johnson¹, Raymond M. Kraus¹, Myung Dong Choi¹ and Robert C. Hickner¹,²

¹Human Performance Laboratory, Department of Exercise and Sport Science, College of Health and Human Performance, ²Department of Physiology, Brody School of Medicine, East Carolina University, Greenville, NC 27858, ³Departments of Nutritional Sciences and Internal Medicine, University of Missouri, and Harry S. Truman VA Hospital, Columbia, MO 65211

Running Head: Metabolic Effects of Acute Resistance Exercise

Corresponding Author:
Robert C. Hickner, Ph.D.
Department of Exercise and Sport Science
Department of Physiology, Brody School of Medicine
Human Performance Laboratory
363 Ward Sports Medicine Building
East Carolina University
Greenville, NC 27858
Phone: 252-328-4677
Fax: 252-328-4689

Key Words: adipose tissue, fat oxidation, lipolysis, microdialysis, resistance exercise, resting metabolic rate
ABSTRACT

The purpose of this study was to investigate the effect of acute resistance exercise (RE) on lipolysis within adipose tissue and subsequent substrate oxidation in order to better understand how RE may contribute to improvements in body composition. Lipolysis and blood flow were measured in abdominal subcutaneous adipose tissue via microdialysis before, during, and for 5 hours following whole body RE as well as on a non-exercise control day (C) in 8 young (24 ± 0.7 years), active (>3 RE session/week for at least 2 years) male participants. Fat oxidation was measured immediately before and after RE via indirect calorimetry for 45 minutes. Dialysate glycerol concentration (an index of lipolysis) was higher during (RE: 200.4 ± 38.6 vs. C: 112.4 ± 13.1 µmol/L, 78% difference, p=.02) and immediately following RE (RE: 184 ± 41 vs. C: 105 ± 14.6 µmol/L, 75% difference, p=.03) when compared to the same time period on the control day. Energy expenditure was elevated in the 45 min after RE compared to the same time period on the control day (RE: 104.4 ± 6.0 vs. C: 94.5 ± 4.0 kcal/hr, 10.5% difference, p=.03). Respiratory exchange ratio (RER) was lower (RE: 0.71 ± .004 vs. C: 0.85 ± .03, 16.5% difference, p=.004) and fat oxidation was higher (RE: 10.2 ± 0.8 vs. C: 5.0 ± 1.0 g/hr, 105% difference, p=.004) following RE compared to the same time period on the control day. Therefore, the mechanism behind RE contributing to improved body composition is in part due to enhanced abdominal subcutaneous adipose tissue lipolysis and improved whole body fat oxidation and energy expenditure in response to RE.
INTRODUCTION

Resistance exercise (RE) is recommended by both the American College of Sports Medicine and the American Heart Association as an integral part of an exercise program (24, 25). There is substantial evidence showing that aerobic exercise and RE can improve body composition by increasing lean body mass and/or decreasing fat mass (2, 26, 35). However, to our knowledge, no research has been performed to examine the acute effects of RE upon adipose tissue fat metabolism, which may describe how the improvement in body composition is accomplished with RE. Despite a lack of data regarding adipose tissue metabolism, others have found that intramuscular triglycerides stores were reduced following RE and hypothesized that the triglyceride stores were used for fuel during the exercise bout (3, 16). Subsequently, resting respiratory exchange ratio has been shown to be reduced immediately (4) and at 15-hours (6, 20, 21) following a RE bout compared to a nonexercise control day, indicating increased post-exercise fat oxidation.

Additional studies have investigated the acute effects of RE upon substrate oxidation as measured by indirect calorimetry and have found equivocal results. Melanson et al. (19) observed a slight (5%) increase in 24-hour fat oxidation following a resistance exercise bout, but this increase in fat utilization failed to reach statistical significance. It has been suggested that the enhanced fat oxidation observed as an acute response to resistance exercise is due to glucose sparing for the purpose of glycogen replenishment, thus resulting in fatty acids being the primary substrate for energy provision after RE (22). Likewise, de Glisezinski et al. (2) demonstrated that 60 minutes into endurance exercise the highest rate of lipolysis matched a significant increase in fat oxidation. Thus, availability and rate of fatty acid delivery may partially mediate whole-body fat oxidation (8).

Therefore, the purpose of this study was to investigate the effect of acute RE on the rate of lipolysis within adipose tissue and whole-body substrate oxidation in healthy,
resistance-trained males. We hypothesized the following: 1) that strenuous whole-body RE would increase lipolysis, as measured with microdialysis, in abdominal subcutaneous adipose tissue; and 2) that whole-body fat oxidation, as measured by indirect calorimetry, would be increased immediately following RE. Adipose tissue was studied because this is the major source of fatty acids that are oxidized by skeletal muscle over prolonged periods of inactivity and activity. Microdialysis was utilized as a relatively non-invasive method of directly monitoring the release of glycerol from a subcutaneous adipose tissue depot.

MATERIALS AND METHODS

Participants
A pre-participation health history and physical activity questionnaire were used to screen all volunteers for inclusion in this study. Eight young (21-27 years), physically active (>3d RE/week for >2 years) males who were free from any existing acute or chronic illness, known cardiovascular, metabolic or pulmonary disease, did not take any medications or supplements and were non-smokers were recruited for this study. A resistance-trained group was studied because the lipolytic and fat oxidation response to RE and subsequent refeeding is most relevant to this population. All participants were informed both orally and in writing of the purpose, risks, and benefits of the research and gave their written informed consent to participate before beginning the investigation. This study was approved by the East Carolina University Medical Center Institutional Review Board. Participant characteristics are presented in Table 1.

Study Design
Participants reported to the Human Performance Laboratory at East Carolina University on 3 separate occasions. The first visit was used to gather baseline information including height, weight, body composition (7-site skin fold) and 10-repetition maximum (10RM) lifts. In a randomly assigned cross-over design participants completed either a resistance exercise (RE)
or a control (C) treatment on the second and third visits. Prior to the second and third visits, each participant abstained from any vigorous activity, alcohol or caffeine intake for 48 hours. The experimental timeline for visits two and three are shown in Figure 1. All participants remained resting in the supine position during the entirety of both experimental days except for during the RE session on the RE day. The protocol was identical on the control day; however, instead of performing RE, participants remained sedentary in a supine position in the Human Performance Lab. The prolonged period of study was performed to monitor the prolonged effects of RE and a subsequent refeeding. Subsequent studies will be needed to investigate possible differential antilipolytic effects of different refeeding strategies post RE, and to monitor these effects over longer periods of time. A minimum of 7 days separated experimental trials.

Body composition and 10RM strength testing

Participants were weighed on an electronic scale with weight recorded to the nearest 0.1 kilogram and height was measured with a standard stadiometer. Seven-site (chest, midaxillary, tricep, subscapular, abdominal, suprailium, and thigh) skin fold measurements were recorded and percentage of body fat was calculated using the Siri equation (29). The participant’s 10RM’s for the exercises used in the treatment sessions (mean ± SE: chest press, 75.3 ± 4.7kg; lat pull down, 60.7 ± 3.0kg; leg press, 157.8 ± 6.4kg; shoulder press, 52.6 ± 2.5kg; leg extension, 77.1 ± 3.3kg; leg curl, 67.2 ± 4.5kg) were determined on resistance training equipment (Cybex, Medway, MA) using previously described procedures (16, 31). All 10RM testing and RE sessions were supervised by a certified strength and conditioning specialist.

Microdialysis and resistance exercise
Participants entered the laboratory early in the morning (~0700 hours) having fasted for 10-12 hours. Each participant was weighed and then laid down for insertion of the microdialysis probe. A previously sterilized microdialysis probe was inserted into the participant with techniques previously described (9). Briefly, a linear designed probe (BAS LM3 probe: 30mm-0.2 mm dialysis membrane with 35kD pore size – Bioanalytical Systems, West Lafayette, IN) was inserted into the abdominal subcutaneous adipose tissue (scAT). Prior to probe insertion into the abdominal scAT, the skin was swabbed with iodine and the insertion and exit site numbed with a topical ethyl chloride spray to reduce discomfort.

After insertion, the probe was attached to a portable microdialysis pump which continuously perfused (2.0 µl · min⁻¹) a solution (147mM NaCl, 2.7mM KCl, 1.2mM CaCl₂, 0.85mM MgCl₂; order #P000151, CMA/Microdialysis, Acton, MA) containing approximately 10 mM ethanol through the probe. The pumped perfusate was collected at the exit end of the probe (dialysate) and stored at 4 °C for analysis of ethanol (index of local blood flow) within 24 hours and subsequently at −20 °C for later analysis of interstitial glycerol (index of lipolysis). After a 45-minute period for probe equilibration, a new collection vial was added for collection of a baseline sample over 45 minutes. Energy expenditure was also measured via indirect calorimetry (Parvomedics, True Max 2400, Sandy, UT) in participants during this 45-minute period with the room darkened and noise kept to a minimum. Participants were required to remain awake, quiet, and as motionless as possible. Substrate oxidation was calculated using O₂ consumption/CO₂ production and calculations developed by Frayn (5).

Following pre-exercise measures, a new microdialysis collection vial was put in place and the participants were instructed to move to the exercise equipment and begin the exercise protocol. The protocol consisted of the following resistance exercises performed in the listed order: chest press, lat pull down, leg press, shoulder press, leg extension, and leg curl. Each exercise was performed for 3 sets of 10 repetitions with a load equaling 85 –
100% of the individual’s previously established 10RM. Rest periods were kept to 90 seconds between all sets and exercises and the resistance exercise session lasted for a total of 40-45 minutes. The workout was designed to be similar to those from other studies in which plasma catecholamine, anabolic hormones, insulin, and lactate concentrations were significantly affected (17, 18, 34). The experiment was identical on the control day, however, instead of a RE bout, participants were kept recumbent and sedentary.

Immediately following the RE or C period, the participants lay supine to change the dialysate collection vial and to collect respiratory gas for a total of 45 minutes. The abdominal scAT probe remained inserted to measure lipolysis and blood flow over the remainder of the experiment, with dialysate collection vials changed every hour until removal of the probe 540 min (9 h) after the start of the experiment. Two hours after completion of exercise the participants were fed a liquid meal (Glucerna™; 220 kcal per 8 oz, 18% of total kcal protein, 35% of total kcal fat, and 47% of total kcal carbohydrate) that equaled 25% of the individual’s daily resting energy expenditure (calculated from the pre-exercise indirect calorimetry measure). The drink was a controlled simulation of a meal and was given to follow a real-life situation where fasting for more than 16 hours would be unlikely. The participants were then free to leave the lab and go through their normal daily activities; however, they were instructed not to eat another meal or ingest any calories until 2 more hours had passed (~4 hours after exercise).

After leaving the lab, the participants recorded the time, type, and amount of dietary intake for the remainder of the experimental day. The participants were asked to store all collected microdialysis samples in a refrigerator or on ice.

**Dietary Control**

Participants recorded their dietary intake for the 2 days prior to and the day of the initial testing session (randomly assigned as either resistance exercise or control). Each
participant was instructed to replicate what they ate on the days prior to and during the first testing session for the corresponding days with respect to the second laboratory visit so that differences in dietary intake would have limited effect on lipolysis or substrate oxidation (Table 2). Dietary analysis was not performed for the second testing session because it was reported by the participants to be identical to the first testing session as instructed. Previous literature has shown that low levels of glycogen content can effect substrate oxidation, therefore, all subjects consumed a minimum of 200 g · d⁻¹ of carbohydrate for the two days prior to testing (4). Lipolytic response to feeding after RE was studied because it is common to consume some form of nourishment following a RE training bout. This could potentially alter the lipolytic and fat oxidation response following RE, which may have implications for body fat status.

**Microdialysis Sample Analysis**

All microdialysis samples were analyzed for glycerol according to the manufacturers’ instructions (CMA 600 analyzer, CMA Microdialysis, Solna, Sweden). Microdialysis samples were also analyzed for ethanol concentration to determine blood flow in the region of adipose tissue surrounding the probe (10,11) via previously described methods (12,13).

**Statistical Analysis**

Two-way [treatment (RE day vs C day) * time (timepoints during the microdialysis day)] repeated measures analysis of variance (ANOVA) tests were used to determine differences in energy expenditure, respiratory exchange ratio, fat oxidation, lipolysis and blood flow. Significance was located with Newman Kuels’ post-hoc analysis. The level of significance was set at p<0.05. All values are reported as mean ± standard error unless otherwise noted.
RESULTS

Body weight was not different between trials (C: 90.3 ± 11.3kg vs. RE: 89.7 ± 11.5kg, p=0.2). Energy expenditure was not significantly different at baseline between the RE and C days (C: 91.8 ± 4.9 vs. RE: 89.2 ± 4.4 kcal/h) but was elevated after RE compared to the same time point on the control day (C: 94.5 ± 4.0 vs. RE: 104.4 ± 6.02 kcal/hr, 10.5% difference, p=.03; Figure 2). Respiratory exchange ratio (RER) was lower at baseline on the C day when compared to the RE day (3.7% difference, p=.04). There was a treatment by time interaction (p=.004) for RER, in that there was a reduced RER in the 45 min after RE compared to before exercise on the RE day but there was no change in RER on the C day over similar timepoints. Fat oxidation was lower at baseline on the RE day when compared to the C day (p=.04). A treatment by time interaction was present for fat oxidation (p=.005), in that there was an increased fat oxidation in the 45 min after RE compare to before exercise on the RE day but there was no change in fat oxidation on the C day over similar timepoints. Fat oxidation increased (105% difference, p=.004) compared to the control day, indicating greater reliance on fat as a fuel (Figure 3).

Dialysate glycerol concentration was not different between treatments at baseline (C: 108.9 ± 12.5 vs. RE: 139.5 ± 31.1 µmol/L). There was a treatment by time interaction (p=.034) for dialysate glycerol, in that there was a higher dialysate glycerol during and in the 45 min after RE compare to before exercise on the RE day but there was no change in dialysate glycerol on the C day over similar timepoints. Dialysate glycerol levels were elevated during RE (78%, p=.02) and immediately following RE (75%, p=.03) when compared to the corresponding measurements on the control day (Figure 4).

Outflow/inflow ratio for ethanol (a measurement of abdominal scAT blood flow) was not different during the RE bout compared to corresponding no-exercise time periods during
the control day (C: 0.47 ± .08 vs. RE: 0.48 ± .07), and was not different at any timepoint during the RE compared to C treatment days (Figure 5).

DISCUSSION

Metabolic effects of acute RE

The primary objectives of this investigation were to investigate the effect of acute RE on lipolysis within abdominal subcutaneous adipose tissue and whole-body substrate oxidation in healthy, resistance trained males in order to better understand how RE contributes to improvements in body composition. Using microdialysis, we were able to determine dialysate glycerol concentrations in abdominal subcutaneous adipose tissue before, during and for five hours after resistance exercise (RE) in healthy, physically active, young men. The primary findings from this investigation indicate that energy expenditure and fat oxidation were elevated immediately following RE, while lipolysis was elevated during and immediately following RE.

As anticipated, and in agreement with others (20, 28), energy expenditure in this study was elevated post-exercise for a period of 40 minutes and was significantly higher (10.5%) compared to energy expenditure during the corresponding time on the no-exercise control day. While energy expenditure was only measured before and immediately after resistance exercise in the present study, others have demonstrated an increase in energy expenditure for up to 2, 15 and 38 hours after resistance exercise (1, 20, 28) using a similar RE protocol, thus our subjects likely had elevated energy expenditure for an extended time period.

Dialysate glycerol from microdialysis probes placed in scAT was elevated during (78%) and immediately after (75%) RE when compared to corresponding time points during the no-exercise control day. These data clearly show that RE stimulates increased rates of lipolysis. Interestingly, the recovery of glycerol may change during or after resistance exercise if there is an alteration of blood flow or diffusion properties within adipose tissue. In
light of minor changes in adipose tissue blood flow during resistance exercise, it is unlikely that there were major changes in interstitial glycerol due to blood flow alterations. In addition, it is likely that the increased lipolysis provides fuel for the increased energy expenditure that is seen during and after a RE bout. Earlier work from Hurley et al. (14) and Tesch et al. (32) showed that plasma catecholamine concentrations are markedly increased during heavy resistance exercise compared with endurance exercise performed at the same energy expenditure. An additional question is how long are catecholamines elevated after exercise, and could growth hormone, another potent activator of lipolysis also be playing a role.

Although not measured in our study, a previous study from Goto et al (7) used a similar RE protocol and found that epinephrine and norepinephrine levels were significantly elevated immediately post exercise, but that the levels were similar to pre-exercise levels by 15 and 30 min post RE. However, they did find that growth hormone levels were significantly increased (80-90%) immediately, 15 min, and 30 min following the RE bout. Thus, growth hormone levels could play a role in the elevated lipolysis we witnessed after RE. Although no attempt was made in this study to determine what caused the increase metabolic rate or change in fat metabolism, a rise in catecholamines likely contributed to the increased lipolysis (2). It should also be noted that RE can also lower intramuscular lipids in skeletal muscle presumably by activating lipolysis. Like lipolysis in subcutaneous adipose tissue, catecholamines can activate lipolysis in the intramuscular lipid stores. Interestingly, little is known the amount of substrate derived from intramuscular lipid stores with intensive exercise. Future studies measuring lipolysis in the interstitial space of skeletal muscle may provide answers.

Although it has been reported that intramuscular lipids are utilized during RE, it is presumed that the immediate and glycolytic energy systems provide most of the energy during intensive RE (33), which leads to a significant lowering of glycogen stores in recruited
muscle (3). It has been suggested that the increase in fat oxidation after a RE bout allows for available glucose to be utilized for glycogen restoration as the skeletal muscle switches to utilizing the elevated fatty acids as the primary energy source (22). Whole body fat oxidation, as indicated by a significant reduction in respiratory exchange ratio, was indeed increased (105%; 5.3 g/hr) following RE when compared to pre-exercise and compared to the same time on the control day. Previous literature supports our data, as respiratory exchange ratio has been shown to be reduced immediately (4) and at 15-hours (6, 20, 21) following a RE bout compared to a non-exercise control day, indicating increased fat oxidation after RE. However, when averaged over a 24-hour period, one group (19) has observed only a slight, non-significant increase (5%) in 24-hour fat oxidation following a resistance exercise bout. The increased fat oxidation is therefore relatively small when considered in the context of total energy expenditure over a 24-hour period.

There was no measurable change in subcutaneous abdominal adipose tissue blood flow in this study of resistance exercise. The authors are unaware of any data on adipose tissue blood flow during resistance exercise. The microdialysis ethanol technique has been used to detect a two-fold increase in adipose tissue blood flow in response to aerobic exercise. This is a relatively small absolute increment in blood flow in comparison to the large rise in skeletal muscle blood flow during exercise. Adipose tissue blood flow may increase more over the active limb than in other adipose tissue depots (30), which may explain why there was no measurable increase in abdominal adipose tissue blood flow in the present investigation.

A few methodological limitations exist and need to be addressed. Participants were allowed to eat and go about their normal daily routine after the in-laboratory portion of the experimental day to more closely simulate in-vivo conditions. Participants were therefore ambulatory and collected microdialysis samples five through ten without the supervision of
the research team. Furthermore, participants ate ad libitum following the in-laboratory experimental sessions, as they were not provided foods by the research team other than the first liquid meal on each experimental day. The research team took precautions, however, to minimize compliance deviation between the RE and C experimental days by collecting all dietary logs, by instructing subjects to complete the same type of physical activity before both testing days, and by personal questioning. In addition, it is possible that resting energy expenditure may have been elevated due to anticipatory arousal or excitation from the insertion of the probes, despite not knowing if they were going to exercise or not on the first experimental day and despite allowing for a 45-minute resting period before indirect calorimetry measures. If there was an anticipatory or excitatory stimulation during the basal period, then the exercise and post-exercise increases in oxygen consumption and the post-exercise increase in fat oxidation may have been underestimated. Furthermore, measurement of interstitial and plasma catecholamine concentrations, as well as other regulators of lipolysis and fat oxidation, would help to more specifically determine the cause of increased lipolysis and fat oxidation and should be included with future research. In addition, a similar study using overweight or aged individuals who are initiating a RE program to improve strength and body composition would be relevant and warranted. Future studies are required in these areas. Additional studies using stable isotope tracers to monitor both whole-body lipolysis and fat oxidation may also provide valuable information in future studies.

In conclusion, the novel findings from this investigation are that free fatty acid mobilization in abdominal scAT was increased both during and for at least 40 minutes following 45 minutes of acute resistance exercise in young, healthy active men. In addition, fat oxidation was elevated following RE when compared to the same time point on the control day. Recently, it was shown that dynamic strength training over a period of 3 months was able to increase lipolysis in obese men by more efficiently stimulating beta adrenergic
receptors (23). Therefore, chronic or acute resistance exercise training may help to attenuate weight gain and improve body composition and we have demonstrated that this may, in part, occur through the mechanisms of increasing energy expenditure, abdominal subcutaneous lipolysis and whole body fat oxidation.
Acknowledgements

The authors would like to acknowledge the efforts of Hannah Carrithers, John Carrithers, James Drew, Chris Evans and Patty Brophy for their help with data collection in this study.
References


Ethanol may be used with the microdialysis technique to monitor blood flow changes in

ethanol technique of monitoring local blood flow changes in rat skeletal muscle: implications

14. Hurley BF, Seals DR, Ehsani AA, Cartier LJ, Dalsky GP, Hagberg JM, and


Intramyocellular lipid and glycogen content are reduced following resistance exercise in

Harman E, Maresh C, and Fry AC. Endogenous anabolic hormonal and growth factor
responses to heavy resistance exercise in males and females. *Int J Sports Med* 12: 228-235,

18. Kraemer WJ, Noble BJ, Clark MJ, and Culver BW. Physiologic responses to heavy-


Figure Legends

Figure 1. Study Timeline.

Figure 2. Energy expenditure (kcal/hr) before- and after-resistance exercise or during corresponding control periods on a separate day in trained men. * Different from all other bars (p=0.03).

Figure 3. A) Respiratory exchange ratio before- and after- resistance exercise or during corresponding control periods on a separate day in trained men. * Significantly different from RE day before-exercise bar (p=0.0003); † significantly different from control day before-exercise bar (p=0.04). B) Fat oxidation (g/hr) before- and after- resistance exercise or during corresponding control periods on a separate day in trained men. * Significantly different from RE day before-exercise bar (p=0.005); † significantly different from control day before-exercise bar (p=0.04).

Figure 4. Lipolytic rate, represented by dialysate glycerol concentrations from microdialysis probes placed in subcutaneous abdominal adipose tissue before, during, and following resistance exercise (open circles) or the corresponding timepoint on a control (no exercise; closed squares) day in trained men. * Glycerol concentration on the RE day is significantly elevated above the same timepoint on the control day.

Figure 5. Ethanol outflow/inflow ratio (indicator of adipose tissue blood flow) before, during, and following resistance exercise (open circles) or the corresponding timepoint on a control (no exercise; closed squares) day in trained men. No differences were observed between the resistance exercise day and the control day at any timepoint.
TABLE LEGENDS

**Table 1.** Participant demographic and body composition data. Data are mean ± SE.

**Table 2.** Average dietary intake for two days before and the day of the first testing session (randomly determined to be either resistance exercise or a control period). Data are means ± SD.
STUDY TIMELINE  
(hours)

0700  Enter Lab & Insert Probe
0800  Equilibration of probes
0845  Indirect Calorimetry
0930  Resistance Ex or No-Ex control period
1015  Indirect Calorimetry
1100  Lay supine & rest quietly
1200  Leave laboratory & collect dialysate samples every hour (samples 5 – 10). Eat first meal at ~1400 hours.
1800  Meal

Dialysate Sample
Before-exercise; 0-40
RE; 40-80
After-exercise; 80-120
Liquid Meal 1; 180-240
Meal 2; 300-360
360-420
420-480
480-540

Ethanol Outflow/Inflow Ratio

Control Day
RE Day

Time (min)
<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean ± SE</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>8</td>
</tr>
<tr>
<td>Age (years)</td>
<td>24 ± .7</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>90 ± 4.1</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>183.1 ± 2.3</td>
</tr>
<tr>
<td>Body Fat (%)</td>
<td>9.0 ± 2.1</td>
</tr>
<tr>
<td>Fat Mass (kg)</td>
<td>7.4 ± 1.8</td>
</tr>
<tr>
<td>Fat Free Mass (kg)</td>
<td>75.3 ± 3.3</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>----------------</td>
<td>----------</td>
</tr>
<tr>
<td>Total Calories (kcal)</td>
<td>2564.6 ± 212.9</td>
</tr>
<tr>
<td>Carbohydrate (g)</td>
<td>292.3 ± 21.6</td>
</tr>
<tr>
<td>%</td>
<td>40.1 ± 5.0</td>
</tr>
<tr>
<td>Protein (g)</td>
<td>158.0 ± 15.4</td>
</tr>
<tr>
<td>%</td>
<td>23.1 ± 1.6</td>
</tr>
<tr>
<td>Fat (g)</td>
<td>89.3 ± 5.3</td>
</tr>
<tr>
<td>%</td>
<td>27.7 ± 3.1</td>
</tr>
</tbody>
</table>