Industry Summary

The impact of obesity on women’s health is an important research priority for the National Pork Board; relative to men, women have higher rates of obesity and sustain greater physical impairment as a result. Thus, the overarching goal of the “Protein Optimization in Women Enables Results - Using Protein” (POWR-UP) trial was to explore the potential for higher protein intake at meals to enhance the outcomes of weight reduction in a high risk population, namely women with obesity complicated by weakened muscles. When a high body fat occurs along with reduced muscle mass/function (known as “sarcopenic obesity”), weight loss treatment can be risky. Not just fat will be lost; usually 25% or more of the weight will be lost as lean tissue such as muscle. The POWR-UP trial is built on the theory that generous animal protein (~ 30 grams) at every meal will promote better muscle outcomes during weight loss in terms of size and function; in the case of sarcopenic obesity, this should convey a definite advantage. So POWR-UP compared a traditional weight loss diet to one with 30 grams of high quality protein at each meal during a 6 month obesity reduction in 80 middle-aged and older women (ages 45 to 78 yrs). For two of three meals each day, the protein source was lean pork tenderloin, deli ham, pork chops, and ground pork; the outcome assessments at 4 and 6 months emphasized physical function and body composition.

Results: POWR-UP ended December, 2015, and the results are now being analyzed and reported. We found that the high protein weight loss diet was very well accepted and thus successfully implemented. Protein intakes in the high protein group exceeded the target, with average intakes of 31, 35, and 40 g for breakfast, lunch, and dinner. More importantly, both groups lost significant amounts of body weight and robustly improved their function. The primary measure of function (distance walked in 6 minutes) was significantly increased at 4 months in the high protein group; by 6 months the control group also improved. Many other function tests improved in both groups; body fat and waist circumference were also reduced. Another interesting finding was that older women tended to lose more weight but in a slower manner than younger participants. In summary, our findings support the feasibility and the strong potential functional benefits of including a protein-enhanced weight loss regimen in obesity interventions for older women.
Significance of findings for the industry: The POWR-UP trial is the first to use pork protein to promote muscle function during an intervention for sarcopenic obesity. It provides a valuable illustration of the health-related attributes of lean pork, such as acceptance, use for weight control, and functional benefits as much or greater than with the control diet. These benefits occurred using a diet with 2 servings of lean pork every day for 6 months. Our findings agree with growing scientific evidence (including from our laboratory) that an optimal quality, quantity, and meal distribution of protein aids muscle protein synthesis and function, and likely other metabolic systems as well. If these findings continue to be extended and confirmed, they will lend important support to an upwards revision of protein intake recommendations for older adults, a very important advantage to the industry as a whole.

Connie W. Bales, Ph.D., R.D.
Professor of Medicine, Duke University Medical Center
919-660-7519
bales001 @mc.duke.edu

Key Words: Sarcopenic obesity; high-quality protein; weight loss; physical function; women’s health

Scientific Abstract

The POWR-UP trial examined a protein-enhanced weight loss regimen for the treatment of sarcopenic obesity in middle-aged and older women. Women have higher rates of obesity than men and experience greater physical impairment as a result. Seeking an effective intervention for geriatric obesity, we randomized 80 obese (mean BMI=37.8 kg/m²) women aged 45 to 78 years to a Control-Weight Loss (500 kcal deficit; protein 0.8g/kg body wt; C-WL) or to a High Protein-Weight Loss (500 kcal deficit; protein 1.2 g/kg body wt; 30 g high quality protein at 3 meals; HP-WL) study arm. The protein for HP-WL was provided as pork—tenderloin, deli ham, chops, lean ground—for 2 of 3 meals each day.

Intervention delivery proved highly feasible and efficacious; both groups significantly lowered their calorie intakes ($p<0.001$). Compared to baseline, body weights were lower ($p<0.001$) by 5.7 and 5.2% at 4 months and 6.4 and 6.2% at 6 months for C-WL and HP-WL, respectively (no group difference). The HP-WL increased their protein intakes from 0.8 to 1.3 g/kg body wt/day and achieved (or exceeded) target protein intakes at each meal; average intakes were 31, 35, and 40 g, respectively, for breakfast, lunch, and dinner, compared to 16, 27, and 30 g for C-WL (by 3-day diet record).

Several measures of function showed clinically important improvements. The primary outcome of distance walked in 6 minutes increased ($p<0.01$) at 4 months in HP-WL and at 6 months in both arms ($p<0.01$). Along with 8-foot up and go scores ($p<0.01$), Short Physical Performance Battery scores also improved ($p<0.001$) at 4 and 6 months in both groups; however, only the HP-WL improved significantly ($p<0.01$) in the gait speed component. As expected, reductions in lean mass, fat mass, and waist circumference occurred at 4 ($p<0.01$) and 6 months ($p<0.01$) in both groups. Age tended ($p=0.058$) to be positively associated with weight loss and affected the time course, such that being older was associated with more weight loss at 6 than at 4 months ($F (1,48) = 4.71, p=0.03$).

Implications: In summary, both C-WL and HP-WL lost weight and robustly improved their ability to function. These findings agree with growing scientific evidence (including from our laboratory) that an optimal quality, quantity, and meal distribution of protein aids muscle function, and likely other metabolic systems as well. If these findings continued to be extended and confirmed, they will lend important support to an upwards revision of protein intake recommendations for older adults. In summary, our findings support the feasibility and the strong potential functional benefits of including a protein-enhanced weight loss regimen in obesity interventions for older women.
Introduction:

Background: As the obesity epidemic continues, Americans face the prospect of health complications in later life that far exceed any observed in recent generations. Obesity (body mass index $\geq 30$ kg/m$^2$) is directly linked with many life-threatening chronic illnesses (e.g., cardiovascular disease, type 2 diabetes), as well as a newly recognized health concern, namely, its threat to functional independence.$[1, 2]$ This further underscores the importance of finding ways to prevent the negative health scenarios linked with obesity. The POWR-UP study examined a practical, lifestyle-based intervention to circumvent this threat, using a high protein weight reduction regimen in middle-aged and older women.

As they progress through middle and older ages, most adults experience a gradual loss of muscle mass and strength in a process known as “sarcopenia.”$[3]$ Sarcopenia is likely related to an age-associated blunting of the anabolic response to nutritional stimuli, as well as a marginally low protein intake, and leads to a decline in physical strength, mobility, and vitality, prompting subsequent loss of functional ability.$[4]$ In societies with high rates of obesity, sarcopenia often “co-occurs” with an elevated accumulation of body fat, a condition referred to as “sarcopenic obesity.” A growing body of literature has established that sarcopenic obesity carries the cumulative risk to health and function of both muscle deterioration and excess adiposity.$[4]$ Women are at a particularly high risk of developing this condition because, relative to men of the same age, they have more fat mass and lower absolute and relative muscle strength.$[5, 6]$ Currently in the U.S., both women (36%) and men (37.2%) have high rates of obesity in middle age (40-59 years) and the obesity rate in women (42.3%) surpasses that of men (36.6%) with aging (>60 yrs).$[7]$ Indeed, the consequences of obesity are more severe in women compared to men, so that relatively small losses of muscle strength translate into serious limitations in mobility.$[8, 9]$ There is strong evidence that women having a high percent body fat, along with a body mass index (BMI) of $\geq 30$ have a greatly increased (up to double) likelihood of developing functional limitations.$[10, 11]$ Our study included women from middle age onward because beginning at maturity the body begins a natural shift towards having more fat and less lean muscle mass. Thus the aging process seriously compounds the negative impact of obesity on function in mature women.$[8, 12]$

A High-Protein Intervention to Reduce Risk of Sarcopenic Obesity: Weight loss benefits physical function as well as a variety of metabolic parameters$[13]$, but it can also have negative consequences for those with lowered lean muscle mass and/or muscle strength. With traditional weight loss approaches, 25% or more of the total weight lost can occur as loss of lean tissue.$[14]$ This accounts for the common recommendation to use exercise as a weight reduction intervention. However, individuals with functional deficits are unlikely to
be able to achieve a level of physical training sufficient to fully protect muscle mass. Our work targets ways to circumvent this challenge and offer recovery of function and independence to obese women who need to lose weight but are unable to exercise vigorously. Knowing that simply reducing body fat improves function [15], we seek interventions that will also protect lean mass and further improve the ratio of lean to fat mass.

Our proposed intervention includes generous amounts of high quality protein three times daily and is based on encouraging findings by other scientists looking at protein metabolism in non-obese individuals with low muscle mass. They have established that the essential amino acids found in complete (animal) proteins, (leucine, in particular) stimulate translation initiation of the mTOR signaling pathway and increase muscle protein synthesis in these individuals.[16, 17] Additionally, protein intakes above the RDA are known to confer a metabolic advantage during weight loss via increased satiety [18], better regulation of energy intake (protein leverage) [19], and protection of bone mineral density.[20] Thus, it seems reasonable to hypothesize that high quality protein will also benefit functionally-limited obese women undergoing a weight loss intervention. In fact, protein supplementation may be especially protective for women whose physical limitations prevent them from participating in moderate to high intensity exercise.

Using protein supplements to spare lean mass during weight loss has been previously investigated by others but very few studies have examined targeted doses of protein throughout the day. This is important, since Symons et al. [21] and others [22] have shown that around 30-35 g of high quality protein per meal is needed for an optimal anabolic response. Mojtahedi et al.[23] provided 25 g of whey protein twice daily in an exercise and weight loss intervention. They found that higher protein intakes increased lean mass relative to body mass, but did not lead to improvements in function. In a study of frail, non-obese older adults, Chale et al. [24] added 20 g of whey protein twice daily to resistance training; they also found no additive functional benefit. We believe the amounts and distributions of high quality protein consumed in these studies were below the threshold intake needed to optimally impact protein synthesis. As illustrated by our recently published work [25], a pattern of at least 30 g of high quality protein 3 times daily over 3 to 6 months may benefit function to a greater extent than weight loss alone.

**Project Objectives:**

The overall Research **Goal** was to assess the effects of a 6-month weight loss intervention that includes generous intakes of protein (predominantly in the form of pork) compared to those of a traditional weight loss control group in a population of obese middle-aged and older women with regards to function, lean mass, and overall body composition. Specific objectives were:
Objective 1:
To compare a traditional weight reduction (Control) diet to one that is specially designed to provide at least 30 g of high quality (animal) protein 3 times daily (lean pork provided for 2 of the 3 meals each day). Specifically, the ability of the high protein diet to preserve lean mass as measured by the BodPod while leading to meaningful weight loss and improvements in functional status as measured by the 6 minute walk test was assessed.

Objective 2:
To determine the effect of the Protein relative to the Control intervention on a variety of important secondary measures of function and strength, including Short Physical Performance Battery (SPPB), 8-foot up and go, and handgrip strength.

Objective 3*:
To compare the Control diet to the Protein intervention with regards to the impact on traditional metabolic markers (lipid profiles, inflammatory markers) and metabolomic profiles as measured in the blood and urine.

*This objective was not part of the original proposal but was added as part of the “add-on” metabolic project and is still in the process of being carried out

Materials & Methods:

Trial Design and Randomization

POWR-UP is a two-armed randomized, controlled trial with primary and secondary outcomes assessed at 0, 4, and 6 months. Using three randomization codes to block by function, race, and marital/partner status, eligible participants were randomly assigned to one of two study arms:

- Traditional weight loss diet: Control-Weight Loss (C-WL)
- Protein-enhanced weight loss diet: High Protein-Weight Loss (HP-WL)

Participants were allocated to study using a computerized centralized randomization scheme generated by the study statistician. The allocation of Control: Protein was 1:2. The 6-month duration was chosen to allow for subjects to gradually lose up to 10% of their baseline body weight and improve their physical function. Primary outcomes were function, measured by the 6-minute walk and lean
mass, measured using the BOD POD™. Secondary outcomes included anthropometrics (total body weight; adipose mass; waist circumference); diet (protein and kcal intake); and other functional measures (Short Physical Performance Battery (SPPB); 8-foot up-and-go; 6-minute; 30-second chair stands; hand grip strength; and physical activity by questionnaire). The study was approved by the Duke University Health System Institutional Review Board (DUHS IRB) before recruitment was initiated and then written informed consent was obtained from all study participants. The first participant was enrolled in January, 2014 and the final outcome assessment was completed in December, 2015.

Participants

Community dwelling women 45 years of age and older with a BMI >30 kg/m2 were recruited using posters, flyers, and digital billboards in Durham, North Carolina, and the surrounding areas. Study inclusion required normal renal function (GFR) for age; those with a GFR ≥ 60 ml/min/1.73 m2 were eligible for enrollment without monitoring and those with a GFR of 45 to 59 ml/min/1.73 m2 were enrolled but monitored with a repeat GFR determination every 2 months. Exclusion criteria included dementia, neurological conditions causing functional limitations, and unstable or terminal medical conditions. The individual and group sessions and all outcome assessments were conducted at Duke University.

Interventions

Registered Dietitians experienced in weight loss interventions implemented a supervised weight loss regimen in both study arms. Each participant was prescribed a hypo-caloric diet to achieve a reduction of 10% of baseline body weight during the 6-month trial. Participants met at least twice with an interventionist to receive their individualized calorie prescription and meal plan. They attended weekly group meetings (specific to study arm) for diet and health-related counseling, peer support, and weekly weigh-ins. Weekly meetings for the two study arms were equivalent in structure and duration. All participants were supplied a low dose multivitamin supplement, along with 400 mg of calcium, and 600 IU of vitamin D to ensure adequate nutrient intake during caloric restriction and to standardize supplement use. Participants were told to discontinue all other dietary supplements for the duration of the study. Interventionists checked daily food logs weekly and provided individualized guidance as needed. 3-day food records, rates of weight loss, and attendance at weigh-ins and group meetings were used to assess adherence. The study analysis was conducted under an ‘intent to treat’ criteria, participants continued to be included in study assessments whether or not they were compliant to the prescribed intervention.

Control Diet
Each Control group participant was prescribed a kcal intake ~500 kcal below their calculated energy requirement and a protein intake meeting the Recommended Dietary Allowance of 0.8 g/kg body weight. The distribution of calories by macronutrient source was 15% protein, 30% fat, and 55% carbohydrates.

**High Protein Diet:**

Each Protein group participant was prescribed a kcal intake ~500 kcal below their calculated energy requirement and a protein intake of 1.2 g/kg of body weight. The distribution of calories by macronutrient source was 30% protein, 30% fat, and 40% carbohydrates. Meal plans for these participants included at least 30 grams of lean, high-quality protein three times a day (at breakfast, lunch, and dinner). Participants were supplied with ≥ 60 g per day of frozen or chilled cooked (ground pork, pork tenderloins, pork chops, and deli ham), and given detailed instructions on how to incorporate the pork into two of their three meals each day. To the meal for which pork was not provided, participants were taught how to add other lean high-quality protein choices to reach the 30 g protein target intake.

**Outcome measurements**

Physical function was measured using the 6-minute walk. The 6-minute walk is used in the clinical setting to test function in older populations (i.e. exercise capacity and ability to carry out activities of daily living) and is a valid method for assessing physical function. Lean and fat mass were measured using the BOD POD™ air displacement plethysmography method (Life Measurement, Inc., Concord, CA) according to our previously established protocol. Waist circumference was assessed at the minimal waist using a Gulick II tape measure. Secondary functional measures included the SPPB, a three component functional assessment measuring balance, strength, and gait speed, the 8-foot-up and go, 30-second chair stands, and hand grip strength. Isometric grip strength was assessed for both hands using the Jamar Hand Dynamometer. The higher of the two scores was reported. Duration of moderate-intensity exercise related activities was assessed using the Community Healthy Activities Model Program for Seniors (CHAMPS) questionnaire.

Energy and protein intake were assessed using 3-day food records collected at 0, 4 and 6 months. Records were checked for completeness and participants contacted for any missing information. Intake of food and beverages was analyzed using Food Processor Nutrition Analysis Software (Version 10.10, 2012, ESHA Research, Salem, OR) to determine daily intakes of calories and macronutrients, as well as protein intake per meal.
Safety

Adverse events were recorded throughout the study, and a fasting blood sample was collected at baseline and end of the study for determination of GFR (LabCorp, Inc.) to assess renal function.

Statistical Analysis

The objective of the trial was to provide information on the feasibility and efficacy of enhancing protein intake in a traditional weight loss intervention. The design included an interim measurement point in order to provide a more precise assessment of the functional form of the compliance by change in function and change in lean body mass. The data were double entered with differences adjudicated and treatment codes were revealed only after the study statistician locked the database at the end of the trial. With regards to primary as well as secondary outcomes, we tested an overall change in both groups and differences in that change between groups over time. The statistical analyses proceeded chronologically in 3 phases: 1) descriptive analyses to summarize the distribution of the covariates and dependent variables, 2) bivariate analyses of the association between group membership and the outcome measures, and 3) controlled multivariable analyses, to assess the association between experimental group and the outcomes, controlling for the important covariates. We analyzed under an 'intent to treat' criteria and controlled for baseline levels of the outcomes of interest.[26] A Mixed Models repeated measures approach[27] was used to assess change from baseline at 2 time points, the 4-month midpoint and the 6-month endpoint. The main effect of the primary outcomes was tested by the Time effect, while the group difference was assessed by statistical significance of the Group and the Group X Time interaction. Statistical significance was declared at level alpha of 0.05 (two-tailed). Since this was not a confirmatory intervention and the limited sample size was likely to lead to Type-II errors, we did not make adjustments for the family-wise Type-I error rate inherent in testing of multiple outcomes.

Results:

(All tables and figures are in Appendix A)

Study Population and Retention

Of 234 eligible individuals entering the initial screening process, 154 did not qualify and were excluded (see Figure 1: Consort diagram). Table 1 shows baseline characteristics for the 80 participants who were enrolled for participation and randomized (C-WL, n=29 and HP-WL, n=51). The study population ranged in age from 45 to 78 years, with a mean age of 60 ± 8.2 years, and was 37.5% African American. Participants
had pronounced (Class II; mean BMI = 37.8 kg/m²) obesity, but mean glucose levels and kidney function indicators were normal. Forty-six percent were married and 96% had at least some college education. Baseline calorie intake was about 1800 kcal and protein intake was $0.8 \pm 0.2 \text{ g/kg body weight/day}$.

**Intervention Delivery and Adherence**

Both study arms had good attendance to the weekly group and weigh-in meetings (C-WL = 69.4%; HP-WL = 77.0%) and reduced their calorie intakes at 3 and 6 months for the C-WL (-642.9 kcal (SD, 697.1) and -574.0 kcal (SD, 588.5; $p<0.0001$) and HP-WL -343.9 kcal (SD, 449.1) and -341.7 kcal (SD, 415.6); $p<0.0001$) groups (Table 2), with no group difference. Analysis of protein intake from 3-day records confirmed the success of the meal-based protein enhancement; at 6 months, protein intake for HP-WL was 31.0 g (SD, 11.6) for breakfast; 34.5 g (SD, 8.0) for lunch; and 40.0 g (SD, 8.5) for dinner, respectively. Intake of protein expressed as g per kg body weight was correspondingly increased to 1.3g in HP-WL; in contrast, C-WL protein intake per meal was decreased and their protein intake in g per kg body weight was unchanged.

**Objective 1:**

To compare a control diet to protein-enhanced diet with regards to meaningful weight loss and the ability to produce improvements in functional status as measured by the 6 min walk and preserve lean mass as measured by the BodPod.

By the 6-month endpoint, both groups had achieved significant ($p<0.001$) amounts of weight loss (C-WL -6.3% (SD, 4.8); HP-WL -6.2% (5.3); Table 3 and Figure 2). As shown in Table 3, both C-WL and HP-WL groups achieved significant improvements in 6-minute walk score; controlling for baseline, distance walked in 6 minutes increased ($p<0.01$) at 4 months in HP-WL and at 6 months in both arms ($p=0.001$). As is expected when body weight is reduced, lean mass was decreased in both groups (C-WL -1.0 kg (SD, 1.1); HP-WL -0.6 kg (SD, 1.1); $p<0.01$); there was no group difference in this change (Table 3).

**Objective 2:**

To compare a Control diet to protein-enhanced diet with regards to secondary measures of function and strength: SPPB, 8-foot up and go, and handgrip strength.

At 6 months, both C-WL and HP-WL had clinically meaningful improvements in SPPB scores (C-WL 1.2 units (SD, 1.0) and HP-WL 1.0 units (SD, 1.4); $p<0.0001$; Table 4); however, only the HP-WL improved significantly ($p<0.01$) in the gait speed component. In agreement with SPPB results, both treatment groups improved performance of the 8-foot up-and go test, at both 4 and 6 months ($p< 0.01$; Table 4), with no significant group effect. Handgrip strength was unchanged in either group.

**BODPOD™ results** indicated a reduction in fat mass in both treatment groups. Reductions in body fat at 4 and 6 months were 4.8 kg (SD, 3.2) and 5.9 kg (SD, 3.7) in the C-WL group ($p< 0.0001$) and 4.1 kg (SD, 3.8)
and 5.2 kg (SD, 5.2) in the HP-WL group (p<0.0001) (Table 4). Waist circumference decreased at both time points for the C-WL and HP-WL groups (p<0.0001); there was no group difference for change in fat mass or change in waist circumference.

**Objective 3:**

To compare a Control diet to protein-enhanced diet with regards to the impact on traditional metabolic markers and metabolomic profiles as measured in the blood and urine.

As previously noted, this objective was not part of the original proposal but was added as part of the “add-on” metabolic project and the major blood analyses are still being carried out. Two protein participants were disqualified when their glomerular filtration rate (GFR) dropped out of the study range but both times this occurred early in the trial and was deemed very unlikely to be protocol related. Otherwise, there were no clinically important changes in GFR during the study in either group (mean GFR at baseline = 85.0 (17.0) ml/min/1.73m²; GFR at 6 months = 84.9 (14.4) ml/min/1.73m²). There were no adverse events related to the protocol and no serious adverse events during the study.

**Discussion:**

POWR-UP findings support the feasibility and strong potential functional benefits of including a protein-enhanced weight loss regimen in obesity interventions for middle-aged and older women. Successful recruitment demonstrated enthusiasm for weight loss interventions among the target population, and participant success at achieving weight loss confirmed its feasibility and their willingness to consume lean pork on a very regular basis. The delivery of 30 g protein per meal, with the majority as lean pork, was highly successful. For example, when offered the option to get their protein from other sources during months 4 to 6, HP-WL participants chose to continue the twice daily pork servings. Dropout rates in the course of this intense, long-term trial were 55% for Controls and 40% for HP-WL. There were no differential predictions of dropout by group, however, two factors predictive of dropping out trended towards significance: African American women (p=0.09) and those with less education (p=0.08) were more likely to dropout.

The most exciting “news” of the trial has to be the clinically important improvements in function experienced by the C-WL, and especially the HP-WL. The primary outcome of distance walked in 6 minutes significantly increased (p<0.01) at 4 months in HP-WL and at 6 months in both arms (p<0.01). The Short Physical Performance Battery (SPPB) scores improved in both groups. However, the significant improvement
of the SPPB gait speed subscale was only found in the HP-WL arm, strengthening the likelihood that protein intake was benefiting walking speed. Supporting this work and our previous findings, new literature continues to increasingly emphasize the potential value of protein supplements or “protein-centric” meals and the importance of complete (animal source) protein for muscle quality [28-30]. Interestingly, we did not find a group effect for the meal-based protein enhancement on retention of lean mass, even though function was clearly improved. This is consistent with studies showing that changes in muscle mass do not fully explain changes in muscle strength and physical function [31, 32]. However, it may also be simply due to a lack of power. In our previous work, posthoc power calculations showed that we would have needed at least 336 subjects to detect a difference in lean mass responses to the treatment.[25]

An unexpected benefit of the POWR-UP trial was that enrolling women with ages ranging from 45 to 78 allowed us to investigate the impact of age on study variables. We found that older women tended to lose more weight and lost it more gradually than young women, both encouraging results for safe and effective weight loss in this population.

In summary, the POWR-UP trial demonstrated that a meal-based higher protein diet was comparable to a traditional diet in achieving weight loss and in improving function in physically limited, obese women, supporting the feasibility and potential functional benefits of this regimen. If confirmed, this practical dietary approach to improve functional status in women with sarcopenic obesity has great potential to ameliorate the health status of this vulnerable population. Our findings also lend support to an upwards revision of protein intake recommendations for older adults, a change recommended by many experts in the field. Future trials with a larger sample size, as well as community studies of feasibility, are well justified.
Appendices

A. Detailed Tables and Figures of Results
   Table 1: Baseline Subject Profile by Treatment Group
   Table 2: Baseline and Change Scores at 4 and 6 Months for (Body Weight and) Dietary Intakes by Treatment Group
   Table 3: Body Weight and Primary Outcome Variables by Treatment Group
   Table 4: Baseline and Change Scores at 4 and 6 Months for Function and Body Composition by Treatment Group
   Figure 1: Consort Chart
   Figure 2: Percent Weight Loss (by Group) for 4 and 6 months

B. Technical and Consumer Related Products
   Example of Facebook Page
   Example of POWR-UP Cookbook

C. References Cited
Table 1: Baseline Subject Profile by Treatment Group

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<th>Control (N=29)</th>
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<td>Glomerular Filtration Rate (ml/min/1.73 m²)*</td>
<td>83.9 (15.3)</td>
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*GFR (mL/min/1.73 m²) = 175 × (Scr)-1.154 × (Age)-0.203 × (0.742 if female) × (1.212 if African American)

**This data comes from another source and is not yet available.

Table 2. Baseline and Change Scores at 4 and 6 Months for Dietary Intakes by Treatment Group

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<td>1709.1 (463.2)</td>
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</tr>
<tr>
<td></td>
<td>Change at 4 months, mean (SD)</td>
<td>Change at 6 months, mean (SD)</td>
<td><strong>p</strong>-values</td>
<td></td>
<td></td>
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<tr>
<td>--------------------------------</td>
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<td></td>
</tr>
<tr>
<td><strong>Protein Intake, g/d</strong></td>
<td>-642.9 (697.1) &lt;.0001 -343.9 (449.1) &lt;.0001</td>
<td>-574.0 (588.5) &lt;.0001 -341.7 (415.6) &lt;.0001</td>
<td>0.64 0.75</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Baseline, mean (SD)</strong></td>
<td>88.9 (23.9)</td>
<td>80.2 (16.9)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Protein Intake, % of total kcal</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Baseline, mean (SD)</strong></td>
<td>0.18 (0.03)</td>
<td>0.20 (0.05)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Change at 4 months, mean (SD)</strong></td>
<td>0.06 (0.05) &lt;.001 0.15 (0.06) &lt;.0001</td>
<td>0.06 (0.05) &lt;.01 0.14 (0.07) &lt;.0001</td>
<td></td>
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</tr>
<tr>
<td><strong>Carb. Intake, % of total kcal</strong></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td><strong>Baseline, mean (SD)</strong></td>
<td>0.45 (0.06)</td>
<td>0.42 (0.08)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Change at 4 months, mean (SD)</strong></td>
<td>-0.09 (0.10) &lt;.0001 -0.11 (0.08) &lt;.0001</td>
<td>-0.09 (0.09) &lt;.0001 -0.10 (0.06) &lt;.0001</td>
<td>0.48 0.82</td>
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<tr>
<td><strong>Fat Intake, % of total kcal</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Baseline, mean (SD)</strong></td>
<td>0.38 (0.07)</td>
<td>0.38 (0.06)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Change at 4 months, mean (SD)</strong></td>
<td>-0.09 (1.0) &lt;.0001 -0.11 (0.08) &lt;.0001</td>
<td>-0.09 (0.09) &lt;.0001 -0.10 (0.06) &lt;.0001</td>
<td></td>
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</tr>
<tr>
<td><strong>Protein Intake Breakfast, g/meal</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Baseline, mean (SD)</strong></td>
<td>13.7 (6.5)</td>
<td>15.3 (8.0)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Change at 4 months, mean (SD)</strong></td>
<td>-0.6 (9.6) 0.57 17.9 (9.9) &lt;.0001 .0001</td>
<td>2.0 (8.2) 0.64 16.1 (11.0) &lt;.0001 .0001</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Protein Intake Lunch, g/meal</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Baseline, mean (SD)</strong></td>
<td>27.8 (12.1)</td>
<td>27.6 (12.1)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Change at 4 months, mean (SD)</strong></td>
<td>-1.3 (11.9) 0.64 9.8 (15.2) &lt;.0001 .001</td>
<td>-1.0 (9.7) 0.68 6.6 (15.0) 0.0001 .01</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Protein Intake Dinner, g/meal</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Baseline, mean (SD)</strong></td>
<td>35.3 (11.2)</td>
<td>33.2 (11.5)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Change at 4 months, mean (SD)</strong></td>
<td>-3.1 (20.2) 0.51 3.5 (13.8) 0.8 0.13</td>
<td>-5.7 (8.2) 0.08 6.5 (14.5) &lt;.001 &lt;.001</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Protein Intake, g/kg of body weight</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Baseline, mean (SD)</strong></td>
<td>0.88 (0.27)</td>
<td>0.82 (0.18)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Change at 4 months, mean (SD)</strong></td>
<td>-0.0006 (0.27) 0.71 0.43 (0.28) &lt;.0001 &lt;.0001</td>
<td>-0.005 (0.22) 0.66 0.43 (0.29) &lt;.0001 &lt;.0001</td>
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</tr>
</tbody>
</table>

*P*-values adjusted for baseline levels.
## Table 3. Body Weight and Primary Outcome Variables by Treatment Group*

<table>
<thead>
<tr>
<th>Outcome Variable</th>
<th>Control N=29</th>
<th>Protein N=51</th>
<th>P value (Between Group)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Body Weight, kg</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline, mean (SD)</td>
<td>103.0 (15.6)</td>
<td>98.6 (18.6)</td>
<td></td>
</tr>
<tr>
<td>Change at 4 months, mean (SD)</td>
<td>-5.66 (3.2)</td>
<td>-5.16 (3.9)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Change at 6 months, mean (SD)</td>
<td>-6.36 (4.9)</td>
<td>-6.15 (5.9)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td><strong>Body Weight Change, %</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Change at 4 months, mean (SD)</td>
<td>-5.56 (3.3)</td>
<td>-5.24 (4.0)</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Change at 6 months, mean (SD)</td>
<td>-6.32 (4.8)</td>
<td>-6.23 (5.3)</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td><strong>6 Minute Walk, minutes</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline, mean (SD)</td>
<td>478.66 (79.3)</td>
<td>494.10 (86.1)</td>
<td></td>
</tr>
<tr>
<td>Change at 4 months, mean (SD)</td>
<td>23.16 (54.4)</td>
<td>45.22 (61.1)***</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Change at 6 months, mean (SD)</td>
<td>46.81 (89.0)*</td>
<td>56.90 (68.0)***</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td><strong>Lean Body Mass, kg</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline, mean (SD)</td>
<td>51.11 (6.2)</td>
<td>48.99 (7.3)</td>
<td></td>
</tr>
<tr>
<td>Change at 4 months, mean (SD)</td>
<td>-0.78 (1.0)</td>
<td>-0.78 (0.99)</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Change at 6 months, mean (SD)</td>
<td>-1.0 (1.1)*</td>
<td>-0.61 (1.1)</td>
<td>&lt;.01</td>
</tr>
</tbody>
</table>

*Baseline values are the observed mean (SE); change scores are the least-squares adjusted means (SE) from the repeated measures analysis.
### Table 4. Baseline and Change Scores at 4 and 6 Months for Function and Body Composition by Treatment Group

<table>
<thead>
<tr>
<th>Secondary Outcomes</th>
<th>Control (N=29)</th>
<th>P valuea</th>
<th>Protein (N=51)</th>
<th>P valuea</th>
<th>P valuea Control vs. Protein</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Body Composition</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lean Mass, %</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Change at 4 months, mean (SD)</td>
<td>-1.50 (1.9)</td>
<td>0.07</td>
<td>-0.99 (4.1)</td>
<td>0.11</td>
<td>0.62</td>
</tr>
<tr>
<td>Change at 6 months, mean (SD)</td>
<td>-1.93 (2.0)</td>
<td>0.03</td>
<td>-0.54 (4.5)</td>
<td>0.49</td>
<td>0.17</td>
</tr>
<tr>
<td>Fat Mass, kg</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline, mean (SD)</td>
<td>51.92 (11.9)</td>
<td>49.41 (13.0)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Change at 4 months, mean (SD)</td>
<td>-4.86 (3.2)</td>
<td>&lt;.0001</td>
<td>-4.07 (3.8)</td>
<td>&lt;.0001</td>
<td>0.45</td>
</tr>
<tr>
<td>Change at 6 months, mean (SD)</td>
<td>-5.93 (3.7)</td>
<td>&lt;.0001</td>
<td>-5.19 (5.2)</td>
<td>&lt;.0001</td>
<td>0.68</td>
</tr>
<tr>
<td>Fat Mass, %</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Change at 4 months, mean (SD)</td>
<td>-2.19 (1.9)</td>
<td>&lt;.0001</td>
<td>-1.95 (2.1)</td>
<td>&lt;.0001</td>
<td>0.68</td>
</tr>
<tr>
<td>Change at 6 months, mean (SD)</td>
<td>-2.67 (2.3)</td>
<td>&lt;.001</td>
<td>-2.72 (2.8)</td>
<td>&lt;.0001</td>
<td>0.81</td>
</tr>
<tr>
<td>Waist Circumference, cm</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline, mean (SD)</td>
<td>104.72 (10.0)</td>
<td>102.54 (11.6)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Change at 4 months, mean (SD)</td>
<td>-4.64 (3.7)</td>
<td>&lt;.0001</td>
<td>-4.18 (4.2)</td>
<td>&lt;.0001</td>
<td>0.66</td>
</tr>
<tr>
<td>Change at 6 months, mean (SD)</td>
<td>-7.42 (3.8)</td>
<td>&lt;.0001</td>
<td>-6.05 (3.3)</td>
<td>&lt;.0001</td>
<td>0.19</td>
</tr>
<tr>
<td>Function</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Short Physical Performance Battery</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Total Score (0-12)</td>
<td>10.10 (1.5)</td>
<td>10.25 (1.5)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Change at 4 months</td>
<td>1.16 (1.0)</td>
<td>&lt;.0001</td>
<td>0.90 (1.4)</td>
<td>&lt;.0001</td>
<td>0.68</td>
</tr>
<tr>
<td>Change at 6 months</td>
<td>1.23 (1.0)</td>
<td>&lt;.001</td>
<td>1.03 (1.4)</td>
<td>&lt;.0001</td>
<td>0.94</td>
</tr>
<tr>
<td>SPPB Balance (0-4)</td>
<td>3.83 (0.6)</td>
<td>3.88 (0.4)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Change at 4 months</td>
<td>0.16 (0.8)</td>
<td>0.20</td>
<td>-0.03 (0.4)</td>
<td>0.37</td>
<td>0.65</td>
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<tr>
<td>Change at 6 months</td>
<td>0.23 (0.8)</td>
<td>0.38</td>
<td>-0.03 (0.5)</td>
<td>0.85</td>
<td>0.55</td>
</tr>
<tr>
<td>SPPB Gait Speed (0-4)</td>
<td>3.76 (0.6)</td>
<td>3.82 (0.4)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Change at 4 months</td>
<td>0.05 (0.4)</td>
<td>0.12</td>
<td>0.10 (0.3)</td>
<td>&lt;.01</td>
<td>0.52</td>
</tr>
<tr>
<td>Change at 6 months</td>
<td>0.15 (0.4)</td>
<td>0.11</td>
<td>0.10 (0.4)</td>
<td>&lt;.01</td>
<td>0.82</td>
</tr>
<tr>
<td>SPPB Chair Stands (0-4)</td>
<td>2.52 (1.0)</td>
<td>2.55 (1.2)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Change at 4 months</td>
<td>0.95 (0.8)</td>
<td>&lt;.0001</td>
<td>0.84 (1.10)</td>
<td>&lt;.0001</td>
<td>0.80</td>
</tr>
<tr>
<td>Change at 6 months</td>
<td>0.85 (1.0)</td>
<td>&lt;.001</td>
<td>0.97 (1.1)</td>
<td>&lt;.0001</td>
<td>0.62</td>
</tr>
<tr>
<td>8 Foot Up-and-go, sec</td>
<td>7.92 (2.3)</td>
<td>7.78 (1.7)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline, mean (SD)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Change at 4 months, mean (SD)</td>
<td>-0.87 (1.9)</td>
<td>&lt;.01</td>
<td>-0.59 (1.3)</td>
<td>&lt;.01</td>
<td>0.71</td>
</tr>
</tbody>
</table>
### Handgrip strength (kg)

<table>
<thead>
<tr>
<th></th>
<th>Baseline, mean (SD)</th>
<th>Change at 4 months, mean (SD)</th>
<th>Change at 6 months, mean (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>25.90 (5.7)</td>
<td>-1.00 (3.8)</td>
<td>-0.62 (4.0)</td>
</tr>
<tr>
<td>Abbreviations: SPPB, Short Physical Performance Battery.</td>
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</tr>
<tr>
<td><em>p</em>-values represent analysis adjusted for baseline values.</td>
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</table>

Figure 1. Consort Chart
Figure 2. Weight Loss Graph (by Group) for 4 and 6 months

<table>
<thead>
<tr>
<th></th>
<th>Baseline</th>
<th>4 month</th>
<th>6 month</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>0</td>
<td>-5.66</td>
<td>-6.36</td>
</tr>
<tr>
<td>Protein</td>
<td>0</td>
<td>-5.16</td>
<td>-6.15</td>
</tr>
</tbody>
</table>

 Consort Enrollment Chart
POWR-UP

Screening

Assessed for eligibility (n=234)

Excluded (n=154)
Did not meet inclusion criteria (n=43)
Schedule conflicts (n=29)
Lost to contact (n=31)
Other reasons (n=61)

Enrollment

Randomized (n=80)

Allocation

Allocated to Control (n=29)
Traditional Weight Loss Group

Allocated to Intervention (n=51)
High Protein Group

Intervention

Completed 6-month Intervention (n=29)
(40% Drop out rate)

Completed 6-month Intervention (n=13)
(35% Drop out rate)
B. Facebook Screen Shot and Cookbook
High Protein, Low Calorie Meals: Recipes from the POWR-UP Study
Example Meals Enjoyed by the Protein Participants

“Protein Optimization in Women Enables Results - Using Protein”

During the course of their POWR-UP participation, many of the ladies enrolled in the Protein-Weight Loss group began to share recommendations and recipes. This prompted conversations about ways to eat more lean protein both within and beyond the weekly nutrition lessons, thus building a special bond as they progressed through their 6 month program. They demonstrated incredible creativity with the Smithfield products as they continued sharing their favorite pork preparation methods and pairing ideas in order to encourage and motivate each other to meet their personal weight reduction goals while consuming two servings of lean pork every day. The entrée section of their cookbook features a few of the stand-out dishes and recipes the study participants voluntarily shared with us. Most are pork dishes, but there are a few with chicken and fish as well, illustrating that they mastered the concept that all complete protein comes from animal sources.

_Funding for the POWR-UP study was provided by the National Pork Checkoff, Smithfield Foods, and the North Carolina Pork Producers Association_

Shredded tenderloin with coleslaw and greens
Tasty ground sausage tortilla
BBQ pork tenderloin in the crock pot

Pork tenderloin, brussel sprouts, and basmati rice

Pork chop with plum sauce

Grill pork tenderloin with cider vinegar marinade and mixed veggies

Roasted chicken breasts with tomatoes and garbanzo beans

entreméés
BBQ Pork Tenderloin in the Crockpot

170 calories per serving  Yield: 8 servings (if using both loins)

Ingredients:

- 1 2-lb pork tenderloin (I have used the 2 packages provided each week in POWR-UP with same amount of sauce ingredients)
- 1 cup ketchup
- ¼ cup brown sugar
- 2 Tablespoons vinegar
- 1 Tablespoon prepared mustard
- 1 Tablespoon Worceester sauce
- 1 Tablespoon reduced sodium soy sauce
- 1 teaspoon chili powder
• 1 garlic clove minced
• 1 Tablespoon dried onion or 1 teaspoon onion powder or sliced fresh onion to taste

Directions:

1. Place the pork tenderloin into the crockpot
2. Mix all the remaining ingredients together and pour over top of the pork tenderloin.
3. Cook on low for 8 hours. Remove from sauce, but keep some for serving if desired.
4. Serve in 4-ounce portions. When reheating, use scant tablespoon of sauce if desired.

Exchanges for one 4 oz serving (1/8 of recipe):

<table>
<thead>
<tr>
<th>Starch</th>
<th>Fruit</th>
<th>Milk</th>
<th>Vegetable</th>
<th>Protein</th>
<th>Fat</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>0</td>
</tr>
</tbody>
</table>

Adapted from food.com  (http://www.food.com/recipe/bbq-pork-tenderloin-in-the-crock-pot-362)

Easy Roasted Pork

180 calories per serving  Yield: 8 servings (if using both loin)
Ingredients:

- 2/3 cup or less brown sugar
- 1/3 cup unsweetened applesauce
- 1 teaspoon ground cinnamon (or to taste)
- 1-1/2 teaspoons ground ginger
- 2 pounds boneless pork loin roast (use 1-2 Smithfield extra tender pork tenderloin)

Directions:

1. Preheat oven to 325 degrees. Lightly flour an oven bag (or use tin foil or crock pot).
2. In a small bowl, blend other ingredients.
3. Place pork in the prepared oven bag. Pour the sauce mix over the roast. Seal bag, and cut several small slits in the top.
4. Cook the roast 45 minutes to 1 hour in the preheated oven, or until the internal temperature has reached 160 degrees. Note: Tenderloins will cook quicker, 35-40 minutes.
5. Serve in 4-ounce portions with a small amount of sauce if desired.

Exchanges for one 4 oz serving:

<table>
<thead>
<tr>
<th>Starch</th>
<th>Fruit</th>
<th>Milk</th>
<th>Vegetable</th>
<th>Protein</th>
<th>Fat</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.5</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>0</td>
</tr>
</tbody>
</table>

Roasted Chicken Breasts with Tomatoes and Garbanzo Beans

260 calories per serving  Yield: 6 Servings

Ingredients:
• 2 lbs boneless, skinless chicken breasts
• 8 oz cherry or grape tomatoes
• 1 15oz can garbanzo beans drained and rinsed
• 6 garlic cloves minced
• 1 T paprika
• 1 t cumin
• 1/2 t black pepper
• 1/2 t crushed red pepper

Directions:
1. Preheat oven to 425.
2. Line a large rimmed baking sheet with foil.
4. Mix all other ingredients together and spread over breasts. Spray with Pam again.
5. Cook about 25-30 minutes.
6. Serve chicken with garbanzo beans and tomatoes spooned over the top.

Exchanges for 1 serving (1/6 of recipe):

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Steph’s Happy Kid Slow Cooker Pork Chops

320 calories per serving  Yield: 2 Servings

Ingredients:

- Ideal slow cooker size: 4-Quart
- 1 pound lean pork chops (or 2 thick POWR-UP chops)
- 1 cup thinly sliced onion
- ¼ cup low sodium soy sauce
- ¼ cup honey
- ¼ cup chili sauce (in the ketchup aisle – get level of heat desired)
- 1 teaspoon curry powder

Directions:

1. Mix ingredients for sauce (everything except pork chops).
2. Put pork and sauce in crockpot, turning chops to coat with sauce. Place Coat all sides of pork chops with sauce mix.
3. Cover and cook on LOW for 5 hours or on HIGH for 3-1/2 hours or until the pork chops are fork-tender.

Exchanges for 1 chop and 3 tablespoons of sauce):

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Source: 365 Slow Cooker Suppers
Maple-Glazed Pork Loin

About 230 calories per serving  Yield: 8 Servings

Ingredients:

Glaze
- 1/3 cup fresh orange juice
- 4 Tbsp. pure maple syrup
- 1 Tbsp. coarse-ground Dijon mustard
- 2 tsp. low-sodium soy sauce
- 1 tsp. dark brown sugar
- ½ tsp. ground cinnamon

Pork
- 3 Tbsp. all-purpose flour
- 1 Tbsp. granulated sugar
- ½ tsp. salt
- ¼ tsp. ground black pepper
- 1 Tbsp. canola oil
- 2 lean pork tenderloins (1 lb each), patted dry

Directions:

1. Preheat the oven to 400 degrees. Add a rack to a large baking pan and coat with cooking spray; set aside.
2. For the glaze, whisk together the glaze ingredients in a small bowl; set aside.
3. On a large baking sheet, combine flour, sugar, salt and pepper. Roll each tenderloin in the flour mixture; shake off the excess. The pork should be lightly coated.
4. In a 12-inch skillet (preferably stainless steel or cast iron), heat the oil over medium-high heat until there are light wisps of smoke. Add the tenderloins to the pan, leaving room between them. Curl the tenderloins if necessary to fit them in the pan. Sear the tenderloins for about 4 minutes per side until nicely browned. Place the seared tenderloins on the rack in the prepared baking pan; set aside.
5. Add the glaze to the skillet and lower the heat to medium. Cook, scraping any browned bits, for about 5 minutes, until the glaze is half the volume. Brush one-third of the glaze over the tenderloins. Roast in the pre-heated oven for about 20 minutes. Brush another third of the glaze and roast for 5 minutes. Remove the pork from the oven, tent with foil, and let it rest for 15 minutes before slicing.

Exchanges for 1 serving (1/8 of recipe):

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28
Glazed Pork and Pineapple Kabobs

About 350 calories per serving  Yield: 6 Servings

Ingredients:

- 2 cups pineapple juice
- ¼ cup lime juice
- 2 Tbsp minced, peeled ginger
- 1 Tbsp. light brown sugar
- ½ tsp course salt, divided
- Freshly ground pepper
- 3 Tbsp hot sauce
- 2 Tbsp cumin
- 2 Tbsp olive oil
- 1 Tbsp minced garlic
- 2 lb pork tenderloin, cut into 1 ½ inch pieces
- 2 cups fresh pineapple chunks
- 1 bell pepper, cut into 1-inch pieces
- 1 small red onion, cut into 1-inch pieces

Directions:

1. Combine pineapple juice, lime juice and ginger in a saucepan and bring to a boil. Reduce heat to medium and cook, stirring occasionally, until mixture is thickened and reduced to 1 cup, about 20 minutes. Stir in brown sugar, ¼ tsp salt and pepper and let cool.


3. Grill kabobs until pineapple and vegetables are evenly charred and pork is cooked through, 9-10 minutes, turning occasionally. Transfer to a platter and brush lightly with glaze.

Serve with remaining glaze on the side.

Exchanges for 1 serving (1/6 of recipe):

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**NOTE:** Fruit and vegetable exchanges will vary if you decide to have more of each
Peachy BBQ Pork

About 239 calories per serving     Yield: 2 Servings (1 serving = 1 cup)

Ingredients:

- ¼ cup BBQ sauce with 45 calories or less per 2 Tbsp serving
- 1 Tbsp sweet Asian chili sauce
- 1 tsp cornstarch
- ½ tsp chopped garlic
- Dash cayenne pepper
- 8 oz raw pork tenderloin, trimmed of excess fat, sliced into 1 inch thick pieces
- 1/8 tsp each salt and pepper
- 1 cup peaches cut into 1-inch chunk (fresh or thawed from frozen)
- ½ cup onions cut into 1-inch chunks

Directions:

1. Preheat oven to 375 degrees. Lay a large piece of heavy-duty foil on a baking sheet and spray with nonstick spray.
2. In a large bowl, combine BBQ sauce, chili sauce, cornstarch, garlic, and cayenne pepper. Mix Thoroughly. Season sliced pork with salt and pepper, and add to the bowl. Add peaches and onion, and stir to coat.
3. Distribute mixture onto the center of the foil. Cover with another large piece of foil. Fold together and seal all four edges of the foil pieces, forming a well-sealed packet.
4. Bake for 25 minutes, or until pork is cooked through and onion is soft.
5. Cut packet to release steam before opening entirely.

Exchanges for 1 serving (1/2 of recipe):

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Brown Sugar Pork Tenderloin

About 270 calories per serving  Yield: 4 Servings

Ingredients

- 1 pork tenderloin cut into 4s
- 1 tablespoon of olive oil
- 2 tablespoons of butter
- 1 teaspoon brown sugar
- 2 minced garlic cloves
- 2 large onions cut in thin wedges
- 2 medium firm pears peeled and cut into wedges

Directions:

1. Brown pork in olive oil (3 minutes on each side). Place in baking dish.
2. Melt butter and brown sugar in pan.
3. Add onions and cook on low until translucent.
4. Add pears and continue to cook for another 7-10 minutes.
5. Pour onions and pears and juice over pork being sure to completely cover pork.

Exchanges per one serving (1/4 of recipe):

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Lemon Crockpot Chicken

About 230 calories per serving    Yield: 6 Servings

Ingredients

- 6 boneless breasts, cut in half
- Salt and pepper to taste
- 2 tablespoons of olive oil
- 1 cup chicken broth
- 3 tablespoons freshly squeezed lemon juice
- ¼ cup flour
- ½ teaspoon ground cumin
- ¾ cup pitted green olives

Directions:

1. Sprinkle chicken with salt and pepper.
2. Brown chicken (3 minutes on each side) in a skillet with olive oil. Transfer to crock pot.
3. Combine broth, juice, flour and cumin in a bowl and stir with a whisk. Pour broth over chicken.
4. Top with onions. Cover and cook on low heat for 6 hours.

Exchanges per one serving (1/6 of recipe):

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Spicy BBQ Salmon & Veggies

About 303 calories per serving  Yield: 1 Serving

Ingredients:

- 2 tbsp BBQ sauce with 45 calories or less per 2 tbsp serving
- 1 tsp Sriracha sauce
- 1 cup broccoli florets
- ½ cup chopped yellow squash
- ½ cup chopped zucchini
- One 4 oz raw skinless salmon fillet

Directions:

1. Preheat oven to 375 degrees. Lay a large piece of heavy-duty foil on a baking sheet and spray with nonstick spray.
2. In a small bowl, mix BBQ sauce with Sriracha sauce until uniform.
3. Lay veggies on the center on the foil. Top with salmon and drizzle with sauce mixture. Cover with another large piece of foil.
4. Fold together and seal all four edges of the foil pieces, forming a well-sealed packet. Bake for 20 minutes, or until veggies are tender and fish is cooked thoroughly.
5. Allow packet to cool for a few minutes, and then cut to release steam before opening it entirely.

Exchanges for 1 serving (1/2 of recipe):

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Super-Special Chicken Sausage ‘n Squash Pack

About 285 calories per serving        Yield: 2 Servings (1 serving = about 2 cups)

Ingredients:

- 3 cups cubed butternut squash
- ¼ tsp. dried ground sage
- ¼ tsp black pepper
- 1/8 tsp salt
- 6 oz (about 2 links) fully cooked chicken sausage with 8g fat or less per 3 oz serving (like the kind by Applegate Organic), sliced into coins
- 1 cup chopped apple
- ½ cup chopped onion

Directions:

1. Preheat oven to 375 degrees. Lay a large piece of heavy-duty foil on a baking sheet and spray with nonstick spray.
2. In a large bowl, sprinkle squash with seasonings and toss to coat. Distribute onto the center of the foil. Top with sliced sausage, apple, and onion. Cover with another large piece of foil.
3. Fold together and seal all four edges of the foil pieced, forming a well-sealed packet.
4. Bake for 45 minutes, or until squash is tender.

Exchanges for 1 serving (1/2 of recipe):

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Herbed-Up Spring Chicken Packet

About 213 calories per serving  
Yield: 2 Servings (1 serving = 1 breast and ¾ cup veggies)

Ingredients:

- 2 cups cherry tomatoes
- 1 tsp olive oil
- 2 tsp chopped garlic
- 1 tsp finely chopped fresh thyme
- ½ tsp each salt and black pepper
- 2 skinless chicken breast (about 4 oz each), pounded to ½-inch thickness
- 1 cup chopped onion
- ½ cup finely chopped fresh basil

Directions:

1. Preheat oven to 375 degrees. Lay a large piece of heavy-duty foil on a baking sheet and spray with nonstick spray.
2. In a medium bowl, drizzle tomatoes with olive oil and toss to coat. Sprinkle with garlic, thyme, and ¼ tsp each with salt and pepper. Mix well.
3. Season chicken with remaining ¼ tsp. each salt and black pepper, and lay cutlets on the center of the foil. Top with seasoned tomatoes, onion, and basil. Cover with another large piece of foil.
4. Fold together and seal all four edges of the foil pieces, forming a well-seasoned packet.
5. Bake for 25 minutes, or until chicken is fully cooked.
6. Cut packet to release steam before opening entirely. Serve it up.

Exchanges for 1 serving (1/2 of recipe):

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Chicken Enchilada Casserole

About 410 calories per serving  Yield: 6 Servings

Ingredients:

- ½ medium white or yellow onion, chopped (about ½ cup)
- 1 cup frozen corn kernels
- 1 tablespoon ground cumin
- 3 (8 inch) whole wheat tortillas
- 1 pound skinless, boneless chicken breast, cooked and diced
- 1 roasted red bell pepper, diced
- 1 (14.5-ounce) can black beans, drained, rinsed, and mashed slightly
- 1 tablespoon chopped cilantro
- 1 ½ cups low sodium salsa (any kind will do)
- 1 cup shredded Monterey Jack Cheese, or queso blanco

Directions:

1. Preheat the oven to 375 degrees
2. Line a deep dish 9” pie pan (or Springfoam cheesecake pan) with foil, then coat with cooking spray.
3. Place a small sauté pan over medium heat. Coat with cooking spray. Add the onion, corn, and cumin, and cook until corn starts to brown, about 5 minutes, then remove from heat.
4. Place one tortilla in the bottom of the prepared pie pan. Layer on half of the chicken, diced pepper, black beans, cilantro, corn and onions. Pour on ½ cup salsa, sprinkle on 1/3 cup cheese and top with a tortilla.
5. Repeat for the second layer, then top with the remaining tortilla, ½ cup salsa and 1/3 cup cheese.
6. Cover with foil and bake for 30 minutes, then remove the foil and bake another 15 minutes.
7. Let cool for 5 minutes before slicing into six wedges and serving.

Exchanges for 1 serving (1/6 of recipe):

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Indonesian Crockpot Chicken

About 240 calories per serving  Yield: 4 Servings

Ingredients

- 4 chicken breasts cut in half
- 1 large onion, thinly sliced
- 15 oz can light coconut milk
- 4 garlic cloves, minced
- 1 teaspoon ground cinnamon
- 1 teaspoon paprika
- 2 teaspoons salt
- ½ teaspoon pepper
- ½ teaspoon cinnamon
- 1 teaspoon coriander
- Zest from 1 lime
- ¼ cup cilantro, chopped
- Juice from 2 limes

Directions:

1. Combine all starred items in a bowl. Rub over chicken thoroughly and use it all. Add extra with coconut milk to crockpot.
2. Place chicken in crockpot and cover with onions. Pour coconut milk and extra seasoning and lime juice.
3. Cover and cook on low for about 5 hours.

Exchanges per one serving (1/4 of recipe):

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