energy than Forwards (1179 ± 316) and Centers (1200 ± 234). Guards consistently expended less energy than Forwards and Centers throughout each quarter. There was a main effect of condition ($p < 0.001$), as more energy was expended in warm-ups than all other quarters.

**Conclusions**

Energy expenditure in games is different for each position. Athletes expend more energy in warm-ups when compared to each quarter. Fuel replenishment or carbohydrate containing hydration protocols should begin after warm-ups and be specific to each position and athlete to optimize in-game performance and to enhance post-game recovery.

**Table 1 (abstract A16).** Calories expended throughout each quarter

| | Pre-Game Warm-up | Max | 1st Quarter | Max | 2nd Quarter | Max | 3rd Quarter | Max | 4th Quarter | Max |
|---|---|---|---|---|---|---|---|---|---|---|
| Guards | 375 ± 89 | 524 | 168 ± 39 | 266 | 208 ± 53 | 344 | 222 ± 53 | 346 | 260 ± 84 | 451 |
| Forwards | 399 ± 130 | 654 | 228 ± 57[#] | 321 | 265 ± 73[#] | 376 | 267 ± 70[#] | 395 | 328 ± 96[#] | 524 |
| Centers | 472 ± 132[#] | 686 | 214 ± 44[#] | 304 | 266 ±47[#] | 370 | 263 ± 53[#] | 379 | 308 ± 84[#] | 498 |
| Team | 418 ± 127[*] | 686 | 210 ± 54[%] | 321 | 249 ± 65[&] | 376 | 254 ± 64[+] | 395 | 304 ± 93[*] | 524 |

Data are Means ±SD for calories expended [*]Different than quarters, ($p < 0.001$); [#]Different than Guards, ($p \leq 0.014$); [†]Different than Forwards, ($p \leq 0.001$); [%]Different than 3rd and 4th quarters, ($p < 0.001$); [&]Different than 4th quarter, ($p < 0.001$); [+]Different than 1st and 4th quarters, ($p \leq 0.027$).

## A17

### The kinetics of muscle carnosine increase with β-alanine supplementation

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Carnosine (Carn: β-alanyl-L-histidine) is the only member of the histidine-containing-dipeptide family found in human muscle. Combined with β-alanine (β-A), the histidine residue of Carn is prevented from participating in protein synthesis enabling high concentrations to be accumulated. In addition, the pKa of the imidazole ring is raised from 6.1 to 6.83 making Carn a highly effective $H^+$ buffer with a power of 0.33 slykes • $mol^{-1}$ Carn, over the pH range: 7.1 (resting pH) to 6.5 (post-exercise).

Synthesis of Carn occurs *in situ* and is limited by β-A which has led to the use of supplements. But what dose and for how long should β-A be taken? From a review of three published studies, it was concluded that the rate of synthesis of Carn with β-A supplementation (*vform*) could be described by zero order kinetics, with a rate constant, $k_f$, linearly related to dose.

$$vform = kf \quad (\text{mmol} \cdot \text{kg}^{-1} \cdot \text{d}^{-1})$$

Further, opposing this is an on-going process of Carn decay at a rate of *vdec* ($d^{-1}$) most probably driven by the spontaneous reaction of Carn with carbonyl groups to form adducts which are then exported from muscle. Carn decay back to the pre-supplementation level (PSL) appears first order where:

$$vdec = -k_d \cdot [\Delta\text{Carn}] \quad (\text{where } \Delta\text{Carn is the increase above PSL})$$

It follows:

$$\text{d}[\text{Carn}]/\text{dt} = vform - vdec = k_f - kd \cdot [\Delta\text{Carn}]$$

and by integration over time:

$$[\Delta\text{Carn}] = (k_f/k_d) \cdot (1 - \exp(-k_d \cdot \text{t}))$$

90% effect of β-A supplementation is predicted after 200+ days and the greatest ΔCarn with the highest dose (up to 6.4g • $d^{-1}$). The model has been used to compare the effectiveness of different β-A formulations on increasing muscle Carn with time; simulating the effects of moving from a vegetarian diet to one containing meat; in accounting for the lower level of Carn in type I muscle fibres; and estimating endogenous β-A synthesis. A study of the effects of increased activity/sedation, diabetes, COPD and sarcopenia on $k_d$ would help illuminate the role of Carn, as a carbonyl group target in health and disease, in suppressing the formation of advanced glycation end (AGE) products.

*Since retiring in 2009, R Harris has acted as a consultant to NAI, Carlsbad, Ca, USA.*

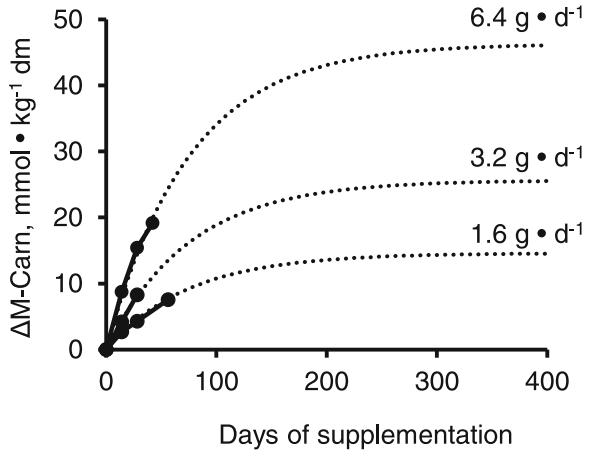


**Fig 1 (abstract A17).** Comparison of the change in muscle Carn with time predicted by the model for subjects supplemented with 1.6 to 6.4 g • $d^{-1}$ β-A (SR CarnoSyn®), with experimental findings from three published studies with $k_d = 0.0133$ • $d^{-1}$ and $k_f$'s of 0.1942 ± 0.0260, 0.3411 ± 0.0252, 0.6161 ± 0.0481 mmol • $kg^{-1}$ • $d^{-1}$ for 1.6, 3.2 and 6.4 g • $d^{-1}$, respectively.

## A18

### Comparative micronutrient adequacy of elite Australian surf lifesavers and non-athlete age- matched young adults

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**Background**

This observational study investigated dietary micronutrient intakes among Australian Surf-lifesaver athletes (Lifeguards). These athletes regularly compete in elite, high intensity surf sports throughout Summer. In order to achieve and maintain power-to-weight ratios conducive to strength and speed, many competitors restrict their dietary intakes, increasing their risk of micronutrient deficiencies. The sequelae of micronutrient deficiencies include poor sports performance and increased risk of low bone mineral density (BMD) and stress fractures. Supplement intakes were also investigated, to determine whether nutritional adequacy was met through supplements if dietary intakes were inadequate.

**Materials and methods**

Dietary and supplement intakes were compared for 9 young adult elite surf-lifesaving competitors (5 males, mean age 21.6±3.8 yrs; 4 females, mean age 20.5±1.7 yrs) with eleven age-matched non- athletes (4 males, mean age 20.5±1.0 yrs; 7 females, mean age 21.9±1.1

yrs). The athletes formed a homogeneous group, with identical training and competition requirements. Dietary adequacy was assessed from 4-day food intake records, using FoodWorks dietary analysis software. Supplement intakes were recorded concurrently with food intakes, using a validated questionnaire. All data were analysed using IBM SPSS Statistics for Windows, Version 22. Within and between group gender differences in dietary intakes were determined using a two-way between factor ANOVA, with post-hoc Bonferroni-correction applied for multiple tests. Bootstrapping was used to correct for small sample size. The alpha level was set at 0.05.

**Results**

Mean dietary iron and calcium intakes among male athletes and non-athletes met the Recommended Dietary Intakes (RDI) from food alone, although this result did not confer a statistically significant difference between all groups, even when supplement intakes were added. Neither female athletes nor non-athletes met the RDI for iron or calcium from dietary sources, but supplement intakes increased iron intakes for female athletes to recommended levels. However the addition of calcium supplements did not increase intakes to RDI levels among female athletes or both non-athlete gender groups and statistical analyses did not show a significant difference between any groups. Contrary to expectations, female athletes showed a significantly higher (p=0.001) mean total energy intake compared to female non-athletes, although no significant differences were observed between male athletes and non-athletes.

**Conclusion**

Insufficient dietary iron and calcium intakes among young adult female Lifeguards place them at risk of growth and performance decrements, low BMD and stress fractures. Male and female non-athletes are similarly at risk, suggesting dietary micronutrient inadequacies may be age-related rather than competitive sport-related. Hence nutrition education is urgently needed among this at risk age-group, regardless of sports participation.

## A19

### Safety, tolerability and nutrient status after consuming a total meal replacement beverage for 30 days: a randomized, placebo-controlled pilot study in healthy adults

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**Background**

Poor nutrition is taking an extraordinary toll on human health and productivity. "Nutrition deserts" may be solved with nutrient-dense, cost-effective and shelf-stable meal replacements. While many studies have evaluated meal replacement diets for weight loss or medical needs, few have evaluated the effects of complete meal replacements in non-obese, healthy adults in a real-world setting [1]. The primary objective of this pilot study was to evaluate the safety, tolerability and changes in nutritional status in 15 healthy adults instructed to consume only a liquid total meal replacement beverage (TMB) for 30 days.

**Methods**

30 non-obese adults (20 female, 10 male) aged 18-40 years with BMI 22-30 kg/m$^2$ in the United Kingdom were randomly assigned to the TMB (Soylent 2.0, Rosa Labs, California) (n=15) ad libitum, or the control group (n=15) who continued their normal lifestyle (Figure 1). Subjects were accustomed to the typical Western diet, had a stable body weight and consumed junk food at least once a week. Treatment was the replacement of all meals and caloric beverages with TMB ad libitum, with a target of 2,000 kcal/day (5 bottles, 400 calories each). Subjects were instructed not to change level of physical activity. Measurements at baseline, 15 and 30 days included body weight, blood count, metabolic profile, blood lipids, liver enzymes, urinalysis, electrolytes and nutrient status. All subjects completed a daily food diary and subjective scales for gastrointestinal discomfort, satiety and mood.

**Results**

29 subjects completed the study. Subjects consuming TMB experienced a modest reduction in body weight compared to the control group (P<0.001), and reduced fasting blood sugar (P<0.05) from baseline. Heavier subjects tended to consume more TMB and lose more weight than lighter subjects (Figure 2). An increase in Vitamin B12 and folate status (P</=0.001) was observed in the TMB group versus control. No other changes in safety-related or nutrient markers were found. Subjects consuming TMB rated high on satiety ratings. Subjective scores for abdominal discomfort and satiety were similar in both groups, with a small percent of subjects reporting transient changes in stomach rumbling. Consistent with previous pilot studies, TMB was safe and well tolerated [2].

**Conclusion**

This 'stress test' human pilot study found consumption of a target of 2,000 kcal TMB for 30 days was safe and well tolerated. TMB maintained or improved body weight and nutrient status and metabolism in this small group of healthy, non-obese subjects.

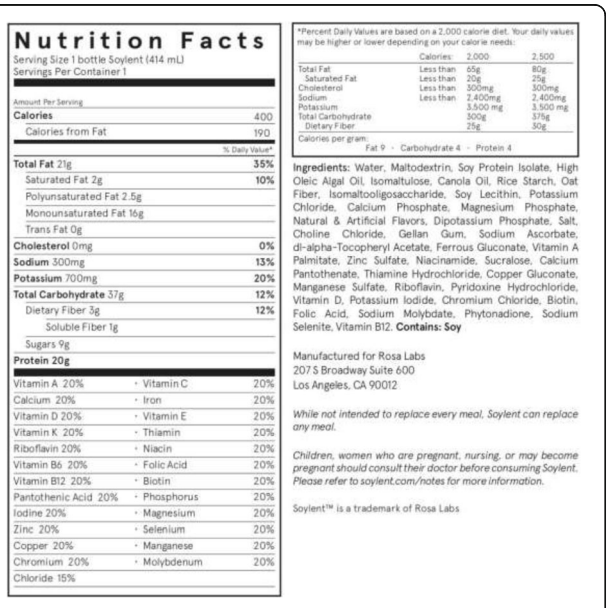
**Acknowledgments**

This study was independently conducted by Leatherhead Food Research, United Kingdom, with approval under REIC reference 080915-3. Rosa Foods, Los Angeles, California sponsored the study, provided financial support and study materials.

NaturPro Scientific LLC conducted an independent scientific review of the study data, and declares no interest or stake in any company or individual involved with the study.

**References**

1. Noakes M, Foster PR, Keogh JB, Clifton PM. Meal replacements are as effective as structured weight-loss diets for treating obesity in adults with features of metabolic syndrome. J Nutr. 2004 Aug;134(8):1894-9.
2. Hsu RH, McCormick DM, Seitz MJ, Lui LM, Rishi HS, Arkin AP. An interventional Soylent diet increases the *Bacteroidetes* to *Firmicutes* ratio in human gut microbiome communities: a randomized controlled trial. bioRxiv 2017; doi: https://doi.org/10.1101/200881



Nutrition Facts

Serving Size 1 bottle Soylent (414 mL)
Servings Per Container 1

| Amount Per Serving | |
|---|---|
| **Calories** | 400 |
| Calories from Fat | 190 |
| | % Daily Value* |
| **Total Fat** 21g | **35%** |
| Saturated Fat 2g | **10%** |
| Polyunsaturated Fat 2.5g | |
| Monounsaturated Fat 16g | |
| Trans Fat 0g | |
| **Cholesterol** 0mg | **0%** |
| **Sodium** 300mg | **13%** |
| **Potassium** 700mg | **20%** |
| **Total Carbohydrate** 37g | **12%** |
| Dietary Fiber 3g | **12%** |
| Soluble Fiber 1g | |
| Sugars 9g | |
| **Protein 20g** | |

| | | |
|---|---|---|
| Vitamin A 20% | · Vitamin C | 20% |
| Calcium 20% | · Iron | 20% |
| Vitamin D 20% | · Vitamin E | 20% |
| Vitamin K 20% | · Thiamin | 20% |
| Riboflavin 20% | · Niacin | 20% |
| Vitamin B6 20% | · Folic Acid | 20% |
| Vitamin B12 20% | · Biotin | 20% |
| Pantothenic Acid 20% | · Phosphorus | 20% |
| Iodine 20% | · Magnesium | 20% |
| Zinc 20% | · Selenium | 20% |
| Copper 20% | · Manganese | 20% |
| Chromium 20% | · Molybdenum | 20% |
| Chloride 15% | | |

*Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs:

| | Calories: | 2,000 | 2,500 |
|---|---|---|---|
| Total Fat | Less than | 65g | 80g |
| Saturated Fat | Less than | 20g | 25g |
| Cholesterol | Less than | 300mg | 300mg |
| Sodium | Less than | 2,400mg | 2,400mg |
| Potassium | | 3,500 mg | 3,500 mg |
| Total Carbohydrate | | 300g | 375g |
| Dietary Fiber | | 25g | 30g |

Calories per gram:
Fat 9 · Carbohydrate 4 · Protein 4

**Ingredients:** Water, Maltodextrin, Soy Protein Isolate, High Oleic Algal Oil, Isomaltulose, Canola Oil, Rice Starch, Oat Fiber, Isomaltooligosaccharide, Soy Lecithin, Potassium Chloride, Calcium Phosphate, Magnesium Phosphate, Natural & Artificial Flavors, Dipotassium Phosphate, Salt, Choline Chloride, Gellan Gum, Sodium Ascorbate, dl-alpha-Tocopheryl Acetate, Ferrous Gluconate, Vitamin A Palmitate, Zinc Sulfate, Niacinamide, Sucralose, Calcium Pantothenate, Thiamine Hydrochloride, Copper Gluconate, Manganese Sulfate, Riboflavin, Pyridoxine Hydrochloride, Vitamin D, Potassium Iodide, Chromium Chloride, Biotin, Folic Acid, Sodium Molybdate, Phytonadione, Sodium Selenite, Vitamin B12. **Contains: Soy**

Manufactured for Rosa Labs
207 S Broadway Suite 600
Los Angeles, CA 90012

*While not intended to replace every meal, Soylent can replace any meal.*

*Children, women who are pregnant, nursing, or may become pregnant should consult their doctor before consuming Soylent. Please refer to soylent.com/notes for more information.*

Soylent™ is a trademark of Rosa Labs

**Fig. 1 (abstract A19).** Nutritional Content of TMB. The total meal replacement beverage (TMB) when consumed as instructed in the study (5x daily) contained 100g protein, 105 grams of fat and 185 grams carbohydrates, including 45 grams of sugar, and 100% daily value of essential nutrients per day