

Journal of Interdisciplinary Science Topics

Could you survive on celery alone?

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07/03/2018

Abstract

This paper examines the feasibility of surviving on a diet consisting exclusively of celery. It provides an estimate of the average basal metabolic rate (BMR) of an adult female, and uses this as the basis for calculations to determine the amount of celery required to maintain a healthy calorific intake. This is compared to the average volume of food consumed by an adult, and assessed for nutritional deficiencies and overdoses. It was determined that an adult female would require a daily intake of over 10kg of celery, and although this would provide sufficient protein and carbohydrates for survival, 10.05kg is not considered to be a feasible amount to consume per day. It was also found that certain micronutrients in celery would be detrimental to health if consumed in such large quantities.

Introduction

The myth that celery is a 'negative-calorie food' (i.e. a food that requires more food energy to be digested than the food provides) is a popular one. Due to this, celery is often espoused by dieting websites as a quick and simple way to lose weight. Although there is little scientific evidence to support the idea that any foods are 'negative-calorie', it is true that celery has very low nutritional content [1].

This paper aims to investigate whether an adult human could survive using celery as their sole source of calories. To do this, the quantity of celery required to sustain the basal metabolic rate (BMR) of an adult human for twenty-four hours will be calculated and critically assessed.

Theory

A recent investigation into the myth of celery consumption resulting in a negative energy balance used female subjects with the following average measurements [2]:

- Age: 23.5 years
- Height: 167cm
- Weight: 59.6kg

For the purposes of this study, the same measurements will be used.

To determine the physical quantity of celery required to sustain a human for a day, the BMR of the subject must be known. This is calculated using the Harris-Benedict Formula, as specified for women (Equation 1) [3]. The Harris-Benedict Formula is used in this context due to its accuracy as a method for approximating an individual's BMR.

$$\begin{aligned} BMR = & 447.593 + (9.247 \times \text{weight in kg}) \\ & + (3.098 \times \text{height in cm}) \\ & - (5.677 \times \text{age in years}) \end{aligned} \quad (1)$$

Using the parameters outlined above, the BMR of the subject was estimated to be 1382.6707 kcal/day. Given that a 100g portion of celery contains ~16 kcal [1], the subject would need to consume ~8.64kg of celery per day to meet their BMR requirements.

However, due to diet induced thermogenesis (DIT), 14% of the celery calories consumed are burnt in the process of consumption [2]. To compensate for this, the amount of celery required for basic function was recalculated, taking DIT into account.

Due to the 14% decrease in calorific content, the subject would now be required to consume ~10.05kg of celery per day. Seeing as a typical celery stalk weighs approximately 0.057kg, the subject would have to eat ~177 medium-sized stalks of celery to meet their BMR.

To put this into perspective, the average NASA astronaut consumes approximately 2.13kg of food per day, compared to the 10.05kg that would be required to survive on celery alone [4]. If the subject were to consume exactly the same weight (of celery) per day as an astronaut consumes (of a balanced diet), the subject would only obtain ~293.09 kcal per day – only 21% of their BMR. A NASA astronaut was used for comparison as their daily intake is tightly controlled and has been tailored to meet the needs of a human at peak fitness.

So, if it were assumed that the subject was to consume a sufficient amount to meet their BMR, how balanced would their diet be? Typically, the average human should consume approximately 0.8g of protein per kilogram of body weight [5]. This means that the subject should consume approximately 47.68g of protein per day. On average, a 100g portion of celery contains 0.7g of protein [1]. If this is multiplied by the 10.05kg required to meet their BMR, the subject would consume approximately 70.35g of protein per day, exceeding the recommended amount by 22.67g.

In terms of carbohydrates, The Dietary Guidelines for Americans recommends that carbohydrates make up about 45-65% of the total calories consumed [6]. This means that the subject would have to consume at least 155g of carbohydrates a day (assuming that carbohydrates provide 4 calories per gram) [7]. 100g of celery contains 3g of carbohydrate, so if the subject consumed 10.05kg of celery per day they would gain 301.5g of carbohydrate – more than their recommended daily allowance [1].

Although the subject would consume enough protein and carbohydrate per day if they ate 10.05kg of celery, their long-term survival would still not be guaranteed. On average, 100g of celery contains

134.7µg of Vitamin A [1]. Therefore, the subject would consume approximately 14143.5µg of Vitamin A per day. Seeing as the tolerable upper limit of Vitamin A for adults is 3000µg/day, the subject would swiftly begin to suffer detrimental effects [8].

Indeed, it is possible for humans to develop acute hypervitaminosis A, a condition characterised by an extreme concentration of Vitamin A in the body, within hours or day of initial ingestion. Symptoms of this include changes to vision, bone pain and skin changes. If the intake of high levels of Vitamin A continues, it can also lead to liver damage and increased pressure on the brain [9].

It is also likely that the consumption of 10.05kg of celery would cause issues with egestion. Humans should aim to consume around 30g of fibre per day to maintain healthy digestion, but the consumption of 10.05kg of celery would provide 201g of fibre [10]. Anecdotal evidence suggests that this would be detrimental to the speed and volume of bowel movements.

Conclusion

From the calculations described above, it is clear that it is not possible to survive on celery alone. The volume of food that a human would have to eat to meet the most basic calorific requirements (10.05kg) would not be physically possible to consume within a twenty-four-hour period. Along with this, if it were assumed that a 'normal' amount of food was consumed each day (except the only food consumed were celery) there would be a significant calorific deficit. This deficit would not be sustainable as a long-term diet without serious health repercussions. Indeed, it has been shown that the consumption of 10.05kg of celery each day would swiftly lead to Vitamin A overdose, which whilst not often fatal, would certainly make life unpleasant.

References

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