TATE & LYLE

KETOGENIC AND LOW CARBOHYDRATE DIET TRENDS AND SCIENCE: HYPE OR HOPE?

There is recent growing interest in the ketogenic (keto) diet by consumers[1-3]. The very low carbohydrate ketogenic diet (VLCKD) involves reducing carbohydrate intake significantly, to less than 20-50 g a day, and increasing the percentage of calories from fat (Table 1). This reduction in carbohydrates puts the body into a metabolic state called ketosis (Figure 1) which differs from diabetic ketoacidosis that has higher serum levels of ketone bodies, glucose, and an absence of insulin[4]. When ketosis occurs, the body utilizes alternate sources for energy, turning fat into ketone bodies in the liver, which can supply energy for the heart, muscle, kidneys, and brain[5].

Table 1. Comparison of low carbohydrate diets to recommended standard dietary patterns

	Dietary Pattern			
Macronutrient*	**Keto (VLCKD)**	**Atkins**	**Dietary Guidelines for Americans[6]**	**WHO and FAO[7,8]**
Carbohydrate	5%	Depends on the phase: 10% or more	45 - 65%	50%**
Protein	20%	25%	10 – 35%	20%
Fat	75%	65%	20 – 35%	Less than 30%

*Represents the percentage of calories suggested from each macronutrient

**The WHO recommends detail should be given in regards to the type of carbohydrate. Of this 50% free sugars should make up less than 10% or reduce to less than 5% for additional health benefits.

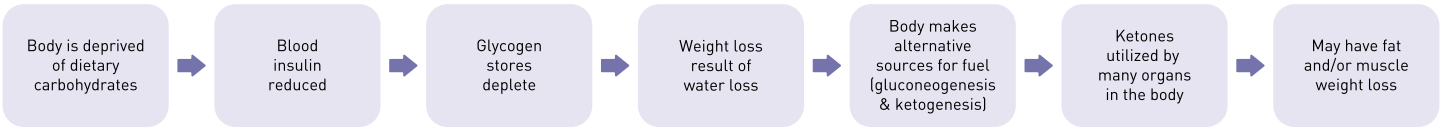

Figure 1. The Process of a VLCKD causing Ketosis[5]

Scientific Evidence for the Ketogenic Diet

Historically, the ketogenic diet has been utilized for epilepsy management[9]. A meta-analysis of thirteen studies lasting longer than a year showed the VLCKD was associated with 0.91 kg more weight loss over a high-carbohydrate, low-fat diet[10]. In contrast, a recent meta-analysis of thirty two studies[11] concluded that fat loss and energy expenditure were larger with low-fat diets compared with ketogenic diets[12]. More research is needed to quantify the impact of the keto diet on body weight. The most impactful way to lose weight is negative energy balance[13]. For those with type 2 diabetes,

reducing carbohydrate intake is important. The optimum levels of carbohydrate reduction in this population, including recommendations to achieve level of VLCKD, needs further research and supervision by a healthcare provider. The main markers to look out for are improvement in HbA1C scores (a marker of long term glucose control), glycaemic control and diet adherence[10,14-19]. In summary, the VLCKD and other low-carbohydrate diets can be useful to individuals, but should be discussed with a health care provider to consider other disease risk factors, such as serum lipid levels and to determine ideal dietary plan for individual circumstances[20,21].

Side effects of very low carbohydrate diets

• Various adverse effects are reported by those on a VLCKD such as constipation, halitosis (bad breath), headaches, muscle cramps, and weakness[13].

• Research shows that eliminating food groups unnecessarily from the diet can lead to nutrient deficiencies (fibre and folate), and create a negative relationship with food, which in extreme cases can lead to eating disorders. It's important to remember that balance, variety and portion control are key.

Currently, there is a lack of certification process by regulatory authorities for 'keto' products. Global dietary guidelines have no provision for recommending a keto diet for the general population.

Low carbohydrate diets may work in the short term. It is important to note that the "best" diet for weight reduction is a diet which results in negative calorie balance, can be sustained long-term, and contains all of the essential nutrients and food groups recommended[13].

Ingredients for calorie reduction

To curb the worldwide obesity and diabetes epidemics, calories need to be decreased in the food supply. A variety of soluble fibres and non- and low-calorie sweeteners can be utilized to reformulate commonly consumed foods and beverages to decrease calories and sugar while still enabling these products to be delicious and enjoyable. PROMITOR® Soluble Fibre has a low glycaemic response, is a well-tolerated prebiotic which provides 2 calories per gram according to the FDA. Ingredients from the PROMITOR® Soluble Fibre family can also be used to reduce constipation, which is commonly associated with adherence to keto diets. Choosing sweeteners such as stevia, PUREFRUIT™ Select monk fruit, or DOLCIA PRIMA® Allulose can also be helpful in moderating fully caloric carbohydrate intake, which is important for blood glucose management and would align with a keto or low-carbohydrate diet plan.

Contact the Global Nutrition team to learn more about quality of carbohydrates and reach out to your sales representative or technical application scientist to learn more about how Tate & Lyle ingredients can be utilized to reduce carbohydrates or calories in your product formulation.

1. IFIC Foundation. Food and Health Survey 2019. **2.** New Nutrition Business. 10 Key Trends in Food, Nutrition & Health 2020. **3.** Walji A. A year of innovation in meal replacement drinks, 2020. Mintel2020. **4.** Paoli A. Ketogenic diet for obesity: friend or foe? Int J Environ Res Public Health. Feb 19 2014;11(2):2092-2107. **5.** Masood W, Uppaluri KR. Ketogenic Diet. StatPearls. Treasure Island (FL): Available from: https://www.ncbi.nlm.nih.gov/books/NBK499830/; 2020. **6.** DGAC. Table A7-1. Daily Nutritional Goals for Age-Sex Groups Based on Dietary Reference Intakes and Dietary Guidelines Recommendations2015-2020. **7.** Mann J, et al. FAO/WHO scientific update on carbohydrates in human nutrition: conclusions. Eur J Clin Nutr. Dec 2007;61 Suppl 1:S132-137. **8.** World Health Organization. Healthy diet. Fact sheet No. 3942018. **9.** Martin K, et al. diet and other dietary treatments for epilepsy. Cochrane Database Syst Rev. Feb 9 2016;2:CD001903. **10.** Bueno NB, et al. Very-low-carbohydrate ketogenic diet v. low-fat diet for long-term weight loss: a meta-analysis of randomised controlled trials. Br J Nutr. Oct 2013;110(7):1178-1187. **11.** Joshi S, Ostfeld RJ, McMacken M. The Ketogenic Diet for Obesity and Diabetes-Enthusiasm Outpaces Evidence. JAMA Intern Med. Jul 15 2019. **12.** Hall KD, Guo J. Obesity Energetics: Body Weight Regulation and the Effects of Diet Composition. Gastroenterology. May 2017;152(7):1718-1727 e1713. **13.** Freire R. Scientific evidence of diets for weight loss: Different macronutrient composition, intermittent fasting, and popular diets. Nutrition. Jan 2020;69:110549. **14.** Schwingshackl L, et al. A network meta-analysis on the comparative efficacy of different dietary approaches on glycaemic control in patients with type 2 diabetes mellitus. Eur J Epidemiol. Feb 2018;33(2):157-170. **15.** Sainsbury E, et al. Effect of dietary carbohydrate restriction on glycemic control in adults with diabetes: A systematic review and meta-analysis. Diabetes Res Clin Pract. May 2018;139:239-252. **16.** Snorgaard O, et al. Systematic review and meta-analysis of dietary carbohydrate restriction in patients with type 2 diabetes. BMJ Open Diabetes Res Care. 2017;5(1):e000354. **17.** Bolla AM, et al. Low-Carb and Ketogenic Diets in Type 1 and Type 2 Diabetes. Nutrients. Apr 26 2019;11(5). **18.** Brouns F. Overweight and diabetes prevention: is a low-carbohydrate-high-fat diet recommendable? Eur J Nutr. Jun 2018;57(4):1301-1312. **19.** Meng Y, et al. Efficacy of low carbohydrate diet for type 2 diabetes mellitus management: A systematic review and meta-analysis of randomized controlled trials. Diabetes Res Clin Pract. Sep 2017;131:124-131. **20.** Kosinski C, Jornayvaz FR. Effects of Ketogenic Diets on Cardiovascular Risk Factors: Evidence from Animal and Human Studies. Nutrients. May 19 2017;9(5). **21.** Mansoor N, et al. Effects of low-carbohydrate diets v. low-fat diets on body weight and cardiovascular risk factors: a meta-analysis of randomised controlled trials. Br J Nutr. Feb 14 2016;115(3):466-479.