



2019 INGREDIENT FORECAST

OCTOBER 2018

RICK RAY

Director, Food Technology, Axiom Foods

SCARLETT FULL, MS, RDN,

Director, Nutrition & Research, Axiom Foods

EXECUTIVE SUMMARY

Axiom Foods, the leading maker of plant proteins in the U.S. is focusing on providing the industry with 5-year forecasts that help food formulators understand and consider applications of plant proteins for food and beverage products. This report includes specifics about functionality, concentration and neutrality trends and solutions.



RICK RAY has spent his career working with food giants from Allied Domecq and General Mills to Coca Cola. Since 2015, Ray has been part of the Axiom Foods team. Ray has been an integral part of monthly flavors brought forth by Baskin Robbins, marrying flavor to coffee before Starbucks realized the market potential and fixing flavor problems that arose with the dawn of microwave cooking technology. Today, he is known for bringing neutrality to musty hemp protein, solubility to gritty rice protein and taking the childhood ick-factor out of pea protein. Ray has been a part of the development teams at all the foremost flavor houses in the U.S. and Europe including Felton, Melcher's, Sensient, Flavorence and Kerry. He is a member of the American Chemical Society and has been a force in research that biochemically explains how we perceive flavors and unlocking the structure of flavor chemicals.

SCARLETT FULL is a registered dietitian nutritionist and member of the Academy of Nutrition & Dietetics. As Director of Nutrition & Research at Axiom Foods, a top plant protein manufacturing company in the U.S., she is committed to increasing the research and understanding of plant-based proteins for the industry and consumers alike. She is also the resident nutrition scientist at Growing Naturals, a popular, Los Angeles-based protein supplement company. Personal battles with health during adolescence fueled her passion for wellness, holistic nutrition and chronic disease prevention. She obtained her undergraduate degree from University of Central Florida and Master's Degree in Dietetics in Nutrition from Florida International University. She specializes in all things protein as well as nutrition communications, having written and contributed thus far to over 200 articles, editorials and white papers.



INTRODUCTION

Since the dawn of refrigeration in the 1950's, the food landscape has changed radically from foods in their whole, original (or close to original) form to processed and reformed foods. The technology that exists today to pull apart foods and use their elements for various functions is still relatively new, but moving forward at warp speed.

Currently, new research has been showing that plants are playing a pivotal role in human health, specifically the fractioning of protein from plants and the use of "waste streams" for food formulations, that until recently, didn't exist.

This paper will discuss the top five forecasts in food formulation trends for 2019. The goals of this white paper are to help food formulators understand and consider applications of trending plant-based ingredients for food and beverage products and provide formulators with forecast ideas for their finished products.

Dairy milk serves as a nutritional and formulation standard based on its high protein content, solubility and other

TREND #1

Larger Variety of Non-Dairy Milks

functional factors that have long since worked for food formulation and cooking. Non-dairy milks became an important part of the landscape as food allergies became recognized as a significant factor, which today is measured by F.A.R.E. (Food Allergy Research & Education) to be 30–50 million Americans who are either intolerant or allergic to dairy products. Currently, dairy stands as #1 on the list of F.A.R.E.'s "Big 8" food allergy list, which also includes: eggs, peanuts, tree nuts, soy, wheat, fish and shellfish.

In a nutshell, the trend for milks will be driven by the consumer, whose perceptions of "added benefits" like fiber and protein specifically, will set the pace for acceptance. Consumers are highly interested in healthful benefits of food products and the existing alternative milks such as almond and cashew milk, only deliver approximately 1.5 nuts per serving, and no protein or fiber. According to 2018 Mintel data, non-dairy milk sales have grown an impressive 61% since 2012.¹

Soy and almond milk have been the largest most commercially available products but are

waning in popularity. Soy milk has decreased in popularity due to allergy issues and almond for the same reason. From a formulator and food marketers' point of view, both have substantially absent nutritional factors in milk form.

Milks made from macadamia, pecans, quinoa, flax, hazelnuts, coconut, pulses (beans), rice and peas are being produced and slowly gaining traction. Flavor innovation has been driving the category forward and formulators should be keen to recognize each source's inherent flavor and functionality. For example, macadamia nut may lend a natural umami flavor while coconut has tropical base which may work well with other tropical fruit flavors. One in 10 dairy and non-dairy milk consumers agree they are buying more milk due to innovative flavors (1).

The newest and most promising of plant milks is happening with oats. Oat milk can be formulated to provide a similar protein profile to dairy milk (approximately 8 grams per serving) and the ingredient naturally delivers a panoply of fiber and nutrients. Thus oat milk, like cow's milk, serves as an excellent starting material for food formulation. Thankfully, one of the largest companies in the oats space, Quaker (owned by Pepsi), is cracking that nut and delivering something that not only tastes good, but because of their massive brand perception and size, it should be a powerful introduction to consumers, as they have the resources to place the product as widely as possible.²

Rice milk is probably one of the most readily available choices of non-dairy milks, mostly because rice is such a commercially viable crop globally (see USDA World Agricultural Report below). The facts that rice is the most hypoallergenic food source and has an inherently neutral flavor, makes the functionality of this ingredient a significant consideration. Rice, of any plant, also contains protein which can be concentrated to the highest percentage available that we know of today. As such, rice in general, has many applications and commercially viable waste streams, which makes it the most globally accepted ingredient, so its presence at this time in history, is probably the most impactful.

It is evident that the dairy alternative segment is skyrocketing as milks are being made from everything from nuts to beans and seeds. As plant-based ingredient functionality improves, they are increasingly popping up in both the frozen and refrigerated dairy aisles. Two plant-based dairy alternative powders produced by Axiom Foods in the U.S. include AvenOlait™ and OryzOlait™ made from sustainably-sourced and allergen-friendly whole grain oats and rice, respectively. Minimally-processed and nutritionally similar to rolled oats, AvenOlait retains key nutrients such as protein, fiber, complex carbohydrates, antioxidants like ferulic acid and essential vitamins and minerals like folic acid, potassium and more. Additionally, AvenOlait is a source of beta-glucan, a type of soluble fiber with benefits linked to blood sugar control, cholesterol-lowering, heart and digestive health. Following suit, OryzOlait is produced without the use of chemicals and also provides key macro- and micronutrients similar to those found in whole brown rice. Both OryzOlait and AvenOlait are Non-GMO Project Verified and certified by the Whole Grains Council to provide 100% whole grains.

METRIC TONS TO BUSHELS

Wheat, soybeans	=	MT * 36.7437
Corn, sorghum, rye	=	MT * 39.36825
Barley	=	MT * 45.929625
Oats	=	MT * 68.894438

METRIC TONS TO 480 LB. BALES

Cotton	=	MT * 4.592917
--------	---	---------------

METRIC TONS TO HUNDREDWEIGHT

Rice	=	MT * 22.04622
------	---	---------------

AREA AND WEIGHT

1 hectare	=	2.471044 acres
1 kilogram	=	2.204622 pounds

The FAS International Production Assessment Division prepared this report. The next issue of World Agricultural Production will be released after 12:00 p.m. Eastern Time, November 8, 2018.

TREND #2

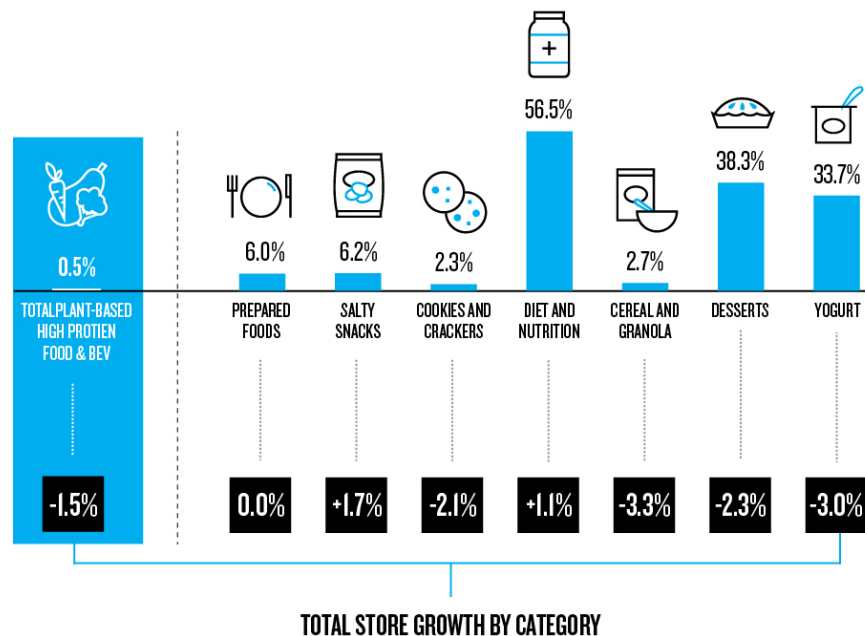
More Neutral and Higher-Concentrated Plant Proteins

For the first time in history, the availability and commercial viability of more neutral and higher-concentrated plant proteins is upon us. The world of fractioning is continuing to evolve with new technologies that changed old separation methods using noxious petroleum-based hexane and now use natural enzymes. Axiom was the innovator of that technology.

While some plant proteins like lupin, cranberry and hemp are only available in 30-60% protein concentration, today, Axiom is leading with technologies that bring the highest industry wide protein concentration of brown rice and peas to the table: up to 90%. For formulators this means that not only can they get exceptionally high-quality product, but they can use less of it to make high protein claims. The higher concentration levels also provide better control over the protein content of a formulation. High protein packaging claims on everything from juice to cookies have been on a wild rise (14% in 2017), so this is significant to the industry.

HIGH PROTEIN PLANT-BASED FOODS ARE SEEING STRONG GROWTH IN SELECT AISLES

Plant-based high protein Food & Bev: High growth categories



Read as: High protein plant-based yogurt grew dollars by 38%, while total yogurt category saw declines of -3%

Source: Nielsen Product Insider, powered by Label Insight, 52 weeks ending 07/08/2017

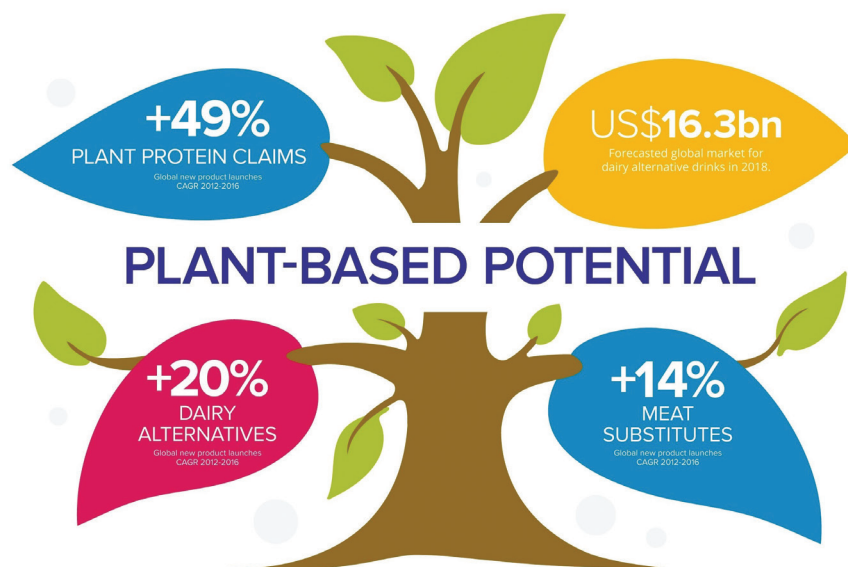
Copyright © 2017 The Nielsen Company (US), LLC. All Rights Reserved.

Up and coming pulse crops like lupin, seem promising, but are years away from viability in the combination of high protein concentrations and in large commercial quantities. Recently though, lupin has been found to grow in many climates outside of its native South America, such as in Nebraska and Australia. Lupin is also attractive due to its nitrogen-fixing capabilities which enrich the ground they grow in and reduce the need for chemical fertilizers.

Cranberry “protein,” while offering a dazzling antioxidant profile, is only available at approximately 30% protein concentration, similar to chickpea protein at 40% concentration, so greater amounts need to be used in order to achieve a high protein content in formulations. This can mean higher costs and less control in meeting specific nutrient goals in formulas.

Plant protein choices for formulators are often based on protein concentration and solubility. Commercial availability is another major consideration, which means that novel plant proteins like cranberry, pumpkin and even hemp are not as affordable to the larger manufacturers.

Inherent flavors also play a major role in formulation; a common challenge with strong-flavored proteins such as hemp or pea. To date, flavor chemists have found ways to mask the mustiness of hemp or the greenness of pea. Good news is afoot in this regard, as one of the first neutral-flavored hemp and pea proteins are new to the market in 2018. Flavor chemists at Axiom Foods are launching VegOtein N™, an 80% neutral pea protein and Cannatein® hemp protein in Q4, so that a full spectrum of flavors, other than vanilla and chocolate, can be created.



Source: Innova Market Insights, 2017

TREND #3

Intestinal Biomes and Healing Foods^{3,4,5}

Incredible new research about gut biomes is impacting the food industry in ways we would never have believed. This new information could have a large effect on human disease research.

The crux of this trend is the discovery of new and very specialized subsets of bacterial cells in the gut, which serve as “signal messengers” directly to the brain. These bacterial cells, which far outnumber human cells in and on the body, affect everything from Krebs cycles and some even produce hormones – but in short, they tell other molecules what to do.

Gut bacteria are the engine of digestion which help transform food into energy for our body. Up until now, it was our understanding that the gut biomes only focused on turning carbohydrates into sugars, but we are now learning that these massive subsets of bacteria have very specialized jobs and some of them convert fiber to sugars.

Because these cells are in the intestinal tract, this research is providing the ability to match specific foods to specific brain messages and molecular behavior. We are just scratching the surface on this technology, but we expect that in the next 20 years this science will provide incredible insight and perhaps allow food scientists to make a significant contribution to disease control.

At the precipice of this trend is the wild growth of kombucha. The fact that probiotic health is something moving into the mainstream is very good news for human health. In 2017, kombucha became a \$1B category. In 2007, there was one kombucha company and today there are 70.

We must find productive ways to feed our intestinal tracts to maintain health and the emergence of these molecule-communicating biomes. This is an exciting area of exploration for food scientists and formulators.

TREND #4

Tailoring Maillard Reactions to Get Specific Animal Protein Flavors^{6,7}

Chefs have long since known that a combination of protein + sugar + heat produces browning and flavors that don't exist separately. Now that plant proteins are becoming much more available and commercially viable, these proteins are becoming the focus of Maillard reaction science. We are beginning to be able to pull plant amino profiles apart and add sugars and heat to create very new flavors; most notably to mimic animal protein flavors.

As evidenced by the largest animal meat makers from Tyson to Cargill, moving away from meat production and investing in and producing plant protein products, the flavor companies are very busily providing the flavors needed. Massive traction has been made toward plant-based foods that not only taste good, but consumers are demanding plant-based foods to look and taste like animal products.

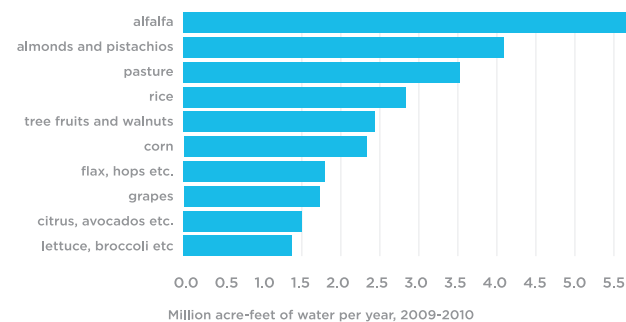
As such, the flavor industry is growing by leaps and bounds to keep up. In the 1980's the number of these companies was under 50; today they number just under 500 and are specializing in ways never needed in the past. Today, one can find flavor scientists who do nothing but baked goods, beverages, ice creams and now many employ flavorists who do nothing but work with plant Maillard reactions.

The use of animal flavors with plant foods is not new—the wild popularity of McDonald's French fries is an example. Before the rise of veganism and vegetarianism, the fast food giant fried their potatoes in beef fat. For the unforeseen future, humans will continue to crave flavors they know, and it will be up to flavor chemists to aid that transition until we evolve beyond that sense memory.

The most popular applications of this technology is to create plant-based flavors like BBQ'd chicken or baked meats. Because of the population explosion expected by 2025, the earth's land and water resources will be stretched beyond what can feed the world with animal. As such, the plant food industry is exploding and there is no sign of stopping.

California's Thirstiest Crops

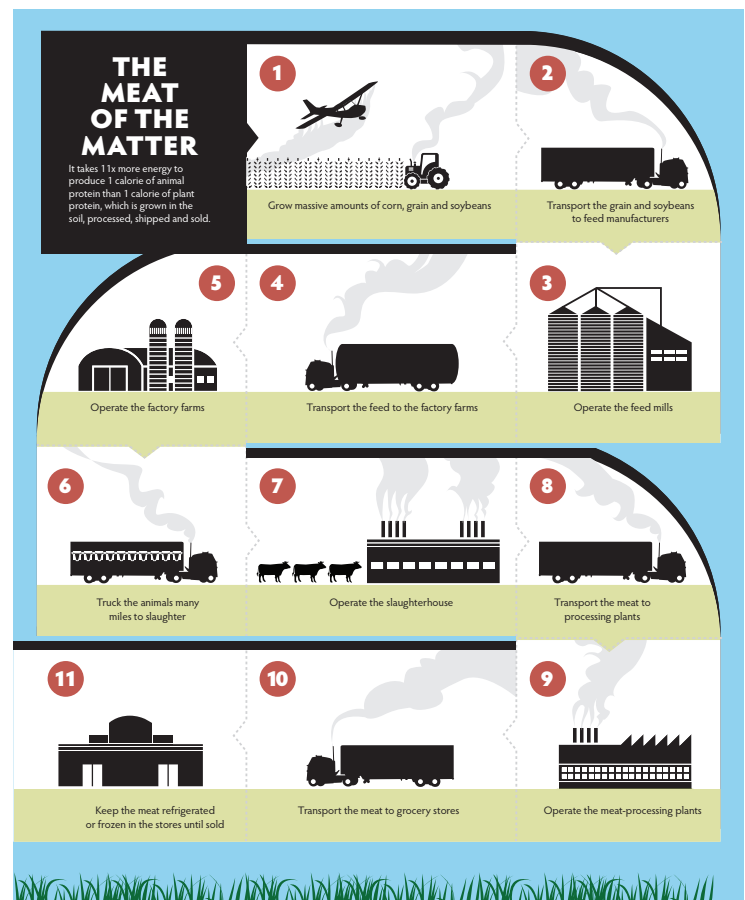
Fodder for cows (alfalfa, pasture, corn) is high on the list



Source: California Department Water Resources

BloombergView

WHY RICE PROTEIN VS. ANIMAL PROTEIN



TREND #5

Improved Absorption Rate of Plant Proteins

For muscle-building, some studies have indicated that fast-digesting proteins (like animal-based whey) are preferred and more beneficial than slow-digesting proteins (like animal-based casein) although the entire body of research in this area does not fully support that notion. Plant proteins like rice protein and pea protein have been shown to be intermediate-absorbing proteins, and as such, have been perceived by some consumers to be inferior to whey for building muscle.⁸

Fortunately, additional research has indicated that the rate of absorption of a protein is not a tell-all regarding its ability to maintain or build muscle mass. In fact, in two separate studies 2013 and 2018, teams of scientists and sport nutritionists determined that Axiom Food's intermediate-absorbing Oryzatein® rice protein was able to build and maintain muscle mass in collegiate and elite athletes to the same degree that fast-absorbing whey protein did.^{9,10}

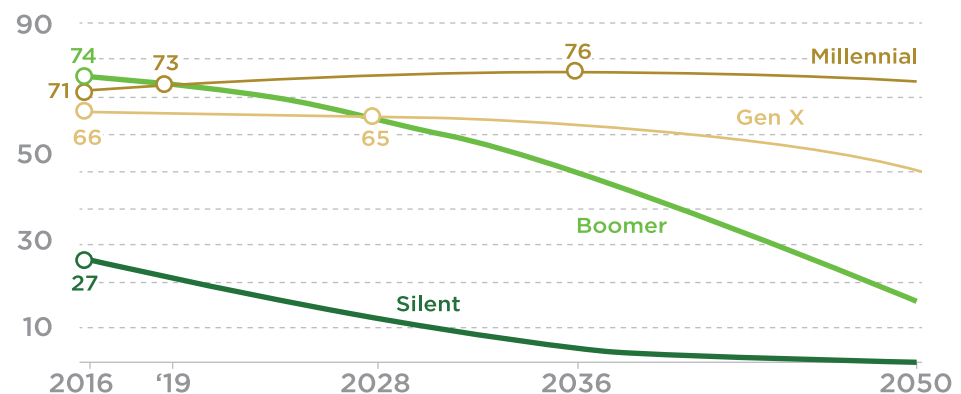
But perception is still a driving force among a skyrocketing health and fitness-driven population (including millennials) so manufacturers are putting plant proteins to the hydrolyzation test. Instead of using acids or harsh chemicals though, natural enzymes and processes are being used to break the proteins into their constituent amino acids for quicker absorption into the body.

Not only will hydrolyzed plant proteins benefit the sports nutrition market, there is a burgeoning market in clinical nutrition and nutrition support for the aged. This is an industry that needs sources of hydrolyzed proteins for tube feeding formulas or drinkable supplements to offer to medical patients dealing with compromised digestive and/or immune systems.

Baby boomers may also benefit from hydrolyzed plant proteins, making it easy on their digestive systems and helping them to reach their increased protein requirements on a daily basis. After the age of 40, the human body loses approximately 4% of muscle mass a year, a condition known as “sarcopenia;” this makes the adequate intake of protein in Boomers more important than ever.

Projected population by generation

In millions



Note: Millennials refer to the population ages 20 to 35 as of 2016.

Source: Pew Research Center tabulations of U.S. Census Bureau population projections released December 2014 and 2016 population estimates.

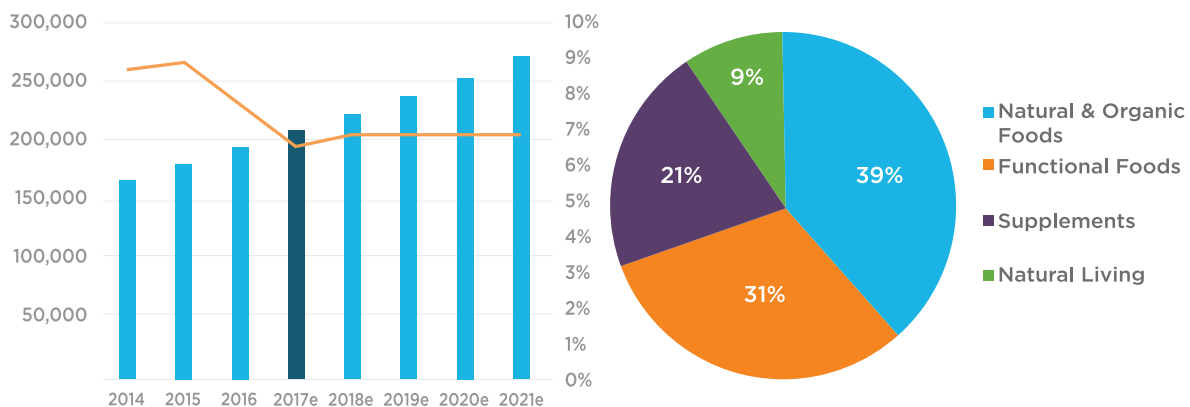
PEW RESEARCH CENTER

ABOUT AXIOM FOODS

On the cutting edge of technology since 2005, Los Angeles-based Axiom Foods is involved in clinical trials, education and affecting change in the global food supply. Owner of the only patented and FDA GRAS brown rice protein on the market, Oryzatein®, Axiom has become one of the largest plant protein makers in the U.S. and also is one of the largest makers of yellow pea protein. Axiom is focused on innovation, that will be removing the grittiness and will make it soluble, and strong-flavored hemp and pea proteins neutral. Axiom brings compassion to the food business by showing that animals are no longer necessary to build muscle and has shown the viability of plant protein versus animal-based whey protein through clinical trials, most recently with pro athletes in the UFC. Annually, Axiom produces an insightful industry-wide CEO Summit adjacent to the Natural Products Expo where executives from every vertical of the sector discuss innovation, trends, breakthroughs and issues in the \$200B naturals industry. In a nutshell, the company is at the forefront of peas and rice becoming the new meat.

U.S. NP industry passed \$200 billion in 2017

U.S. Natural and Organic Product Industry sales grew 6.5% to \$270B in 2017. Natural, organic and functional F&B sales = 70% of sales.



Source: Nutrition Business Journal (2017 preliminary estimates; \$mil, consumer sales)

©2018 New Hope Network | Informa



References

- 1 US Non-Dairy Milk Sales Grow 61% Over the Last Five Years. Mintel. <http://www.mintel.com/press-centre/food-and-drink/us-non-dairy-milk-sales-grow-61-over-the-last-five-years>. Published January 4, 2018.
- 2 Creswell J. Quaker Bets Oat Milk is More than just a Passing Fad. New York Times. <https://www.nytimes.com/2018/10/19/business/quaker-foods-pepsi-oat-milk.html>. Published October 19, 2018.
- 3 David LA, Maurice CF, Carmody RN, et al. Diet rapidly and reproducibly alters the human gut microbiome. Nature International Journal of Science. 2013;(505):559-563
- 4 Parvez S, Malik KA, Ah Kang S, Kim HY. Probiotics and their fermented food products are beneficial for health. Journal of Applied Microbiology. 2006;100(6):1171-1185. doi:10.1111/j.1365-2672.2006.02963.x
- 5 Cryan JF, O'Mahony SM. The microbiome-gut-brain axis: from bowel to behavior. Neurogastroenterology & Motility. 2011;23(3):187-192. doi:10.1111/j.1365-2982.2010.01664.x
- 6 van Boekel MAJS. formation of flavour compounds in the Maillard reaction. Biotechnology Advances. 2006;24(2):230-233. doi:10.1016/j.biotechadv.2005.11.004
- 7 Nursten HE. The Maillard Reaction: Chemistry, Biochemistry, and Implications.; 2005.
- 8 Purpura M, Lowery R, Joy JM, et al. A comparison of blood amino acid concentrations following ingestion of rice and whey protein isolates: a double-blind crossover study. Journal of Nutrition and Health Sciences. 2014;1(3):306. doi:10.15744/2393-9060.1.306
- 9 Joy JM, Lowery RP, Wilson JM, et al. The effects of 8 weeks of whey or rice protein supplementation on body composition and exercise performance. Nutrition Journal. 2013;12(86). doi:10.1186/1475-2891-12-86
- 10 Kalman DS, Escalante A, Hewlings SJ, Willoughby DS. The body composition effects of extra protein in elite mixed martial artists undergoing frequent training over a six-week period. EC Nutrition. 2018;13(6).

