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PHOSPHORUS AND THE HUMAN DIET

Phosphorus (P) is the "key to life" – it is a component of every living plant and animal cell, and a vital element for metabolic processes. In plants, P improves flower formation and seed production, increases stalk and stem strength, and stimulates root development. In addition to aiding plant growth and development, P fertilization can increase flavonoids and other antioxidants in fruits and vegetables, such as apples and tomatoes, resulting in an increase in disease-fighting health benefits for humans. In humans, dietary P builds strong teeth and bones, improves digestion, reduces joint and muscle pain, helps maintain a regular heartbeat, and repairs tissues and cells.

Since P is a critical constituent of all living organisms, it is found in most food sources. Organic P is found in protein-rich foods such as meats, poultry, fish, nuts, beans, cereals, and dairy products. Phosphorus consumed through animal products is absorbed more easily than plant-based P because humans do not have enough of the enzyme necessary to release the P present in plants as phytate. Phytate levels in plants can be reduced through genetics and breeding; however, since it is essential for plant metabolism, doing so may negatively impact seedling emergence and growth if soils are low in available P. Inorganic P, which is easily absorbed by the body, is often added to fast foods, soft drinks, and other processed foods as an additive or preservative.

The recommended dietary allowance (RDA) for healthy adults is 700 milligrams of P per day. Dietary P deficiency in humans is uncommon because it can be easily consumed at the necessary quantity through the food we produce; it is more common to see diets consisting of excess P. Kidneys help remove excess P from blood, maintaining balanced levels. A high concentration of P in the blood is called hyperphosphatemia. Similar to soil-nutrient interactions, if human P intake is too high, it can lead to nutrient deficiencies or adversely affect the body's ability to effectively use other minerals, including iron, calcium (Ca), magnesium, and zinc. For example, elevated P concentrations result in a reduction of absorbed Ca, which could lead to weak bones and osteoporosis. This may also result in the accumulation of Ca deposits in the heart, lungs, and other organs. Soils, unlike the human body, do not have a way to naturally regulate nutrients. For example, if soil pH is high, Ca accumulates and makes

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P less available to plants, which can be critical during the early growth.

The National Health and Nutrition Examination Survey (NHNES) indicates that P intakes have increased over the past 15 years and are exceeding the RDA by 900 milligrams for men and 400 milligrams for women in the United States. This number may be underestimated by 20% because food additives are not always included in the nutrient composition database.

Grains, meat, and milk supply over three-quarters of the daily dietary P. The figure represents the distribution of total dietary P consumed by adults in the United States between 2001 and 2014 by food group. Consumption of dietary P through grains and meat has increased over the past 15 years.

Just like the interaction between soil-nutrients and plants, in order to avoid inadvertent nutrient deficiencies that may affect overall health, it is important to understand nutrient interactions and maintain balanced recommended daily intakes as human diets change based on preference and available food sources.

References

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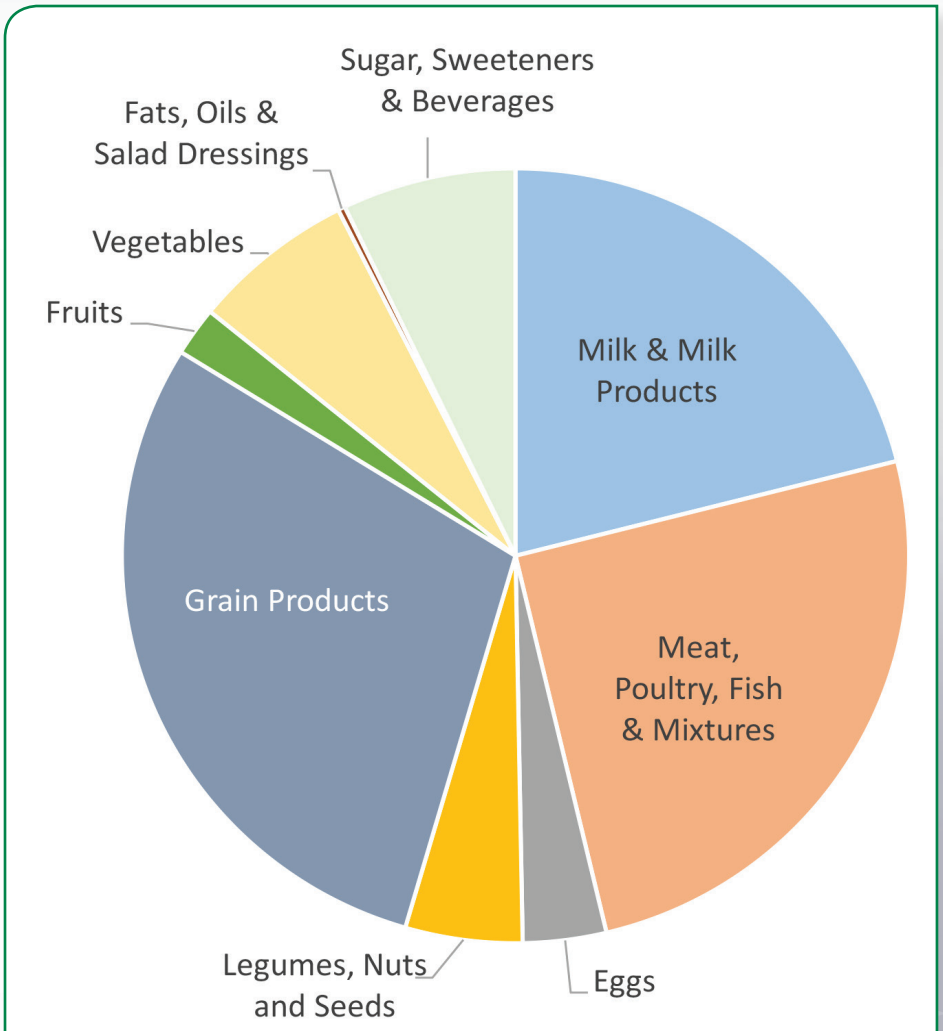

Distribution of total dietary P in adults between 2001 to 2014. From McClure et al. 2017.

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