SUSTAINABLE BIOECONOMY
FOR ARID REGIONS

Separation of a Mixture

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Guar and Guayule

- **Guar** is a drought tolerant, alternative crop for the Southwest USA
  - *This plant produces guar gum and phenolic compounds essential for the food and pharmaceutical industries*
  - *These compounds must be extracted and separated from other plant components*
- **Guayule** is a drought tolerant shrub native to Mexico and Texas
  - *This plant produces rubber, latex, and resins used in the pharmaceutical, biofuel, and tire industries*
  - *These compounds must be extracted and separated from other plant components*

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Separation Techniques

- Plant chemicals can be separated by different techniques including:
  - ***Chromatography****: components move at a different rate*
  - ***Centrifugation****: based on densities of the particles in a mixture*
  - ***Filtration****: mechanical physical separation based on particle size*
  - ***Distillation****: separation of liquids based on their boiling point*
- The use of any of these methods depends on the materials to be separated and the grade of purity desired for each component

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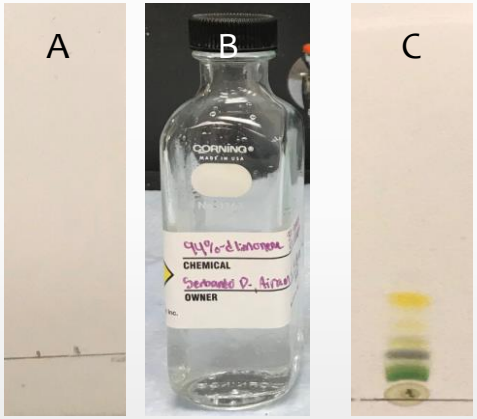
Separation of Plant Pigments by Thin Layer Chromatography (TLC)

- Thin layer chromatography consists of a stationary and a mobile phase (A and B)
- The stationary phase is made of a thin layer of adsorbent material attached to a solid backing; the mobile liquid phase consists of an appropriate fluid placed in a container
- The sample is drawn up by capillary action; separation occurs as a pigment (being different in chemical and physical composition) interacts with the stationary and mobile phases to a varying degree, creating individual bands on the plate (C)



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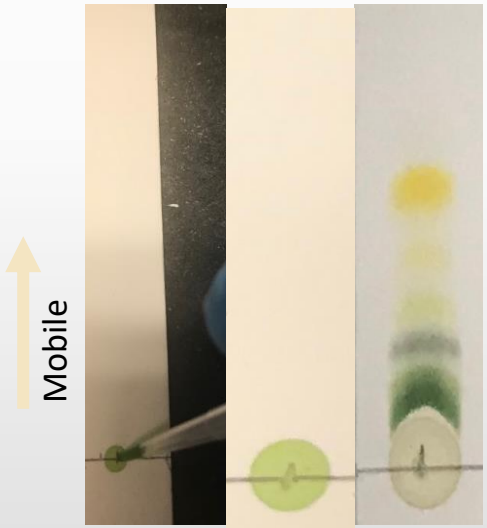
Separation of Pigments from Guar Leaves by TLC

Guar leaves

Pigment extracts



The color of guar leaves is composed mainly of a mixture of five pigments: β-Carotene, Xanthophyll, Lutein, Pheopytin, and Chlorophyll

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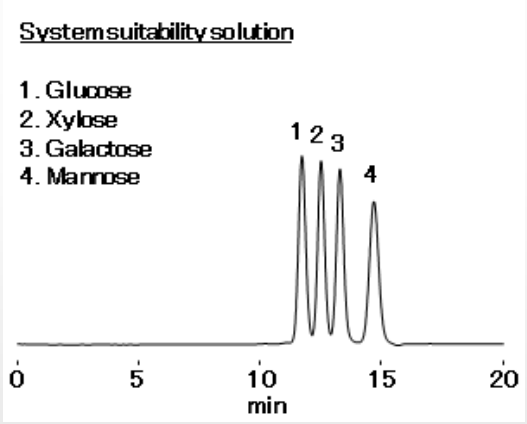
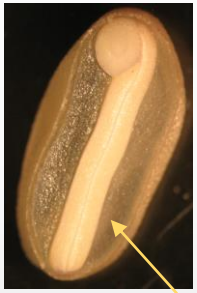
Separation of Plant Chemicals by High Performance Liquid Chromatography (HPLC)

Chromatogram of guar gum separated by HPLC





Guar seed endosperm

- High-performance liquid chromatography (HPLC) can be used to separate molecules by size and by charge.
- The sugars glucose, xylose, galactose, and mannose (peaks 1-4) from guar seed endosperms were separated by HPLC according to their size.

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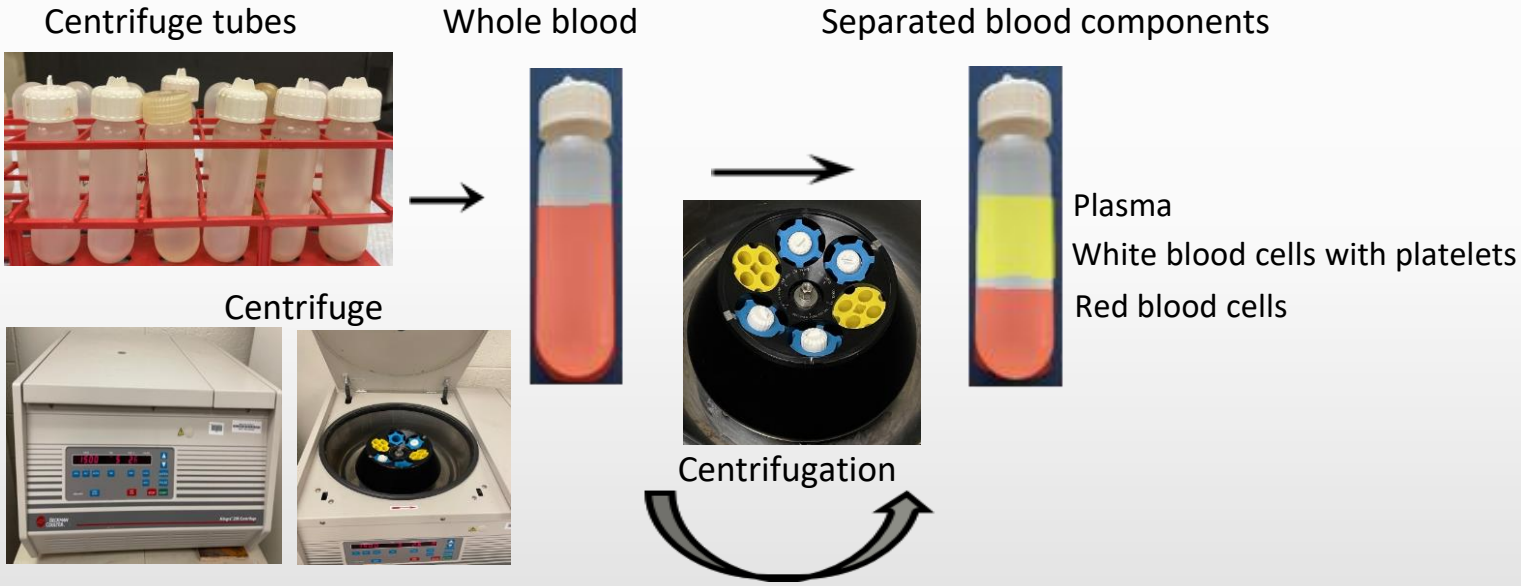
Separation of Blood Components by Centrifugation



- Centrifugation is a mechanical process that involves centrifugal force to separate particles from a mixture according to their size, shape, and density. The larger the size and the larger the density of the particles, the faster they separate from the mixture.
- Whole blood is separated into its components: Plasma, white blood cells with platelets, and red blood cells by centrifugation.

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Separation of a Heterogenous Mixture of Sand and Water by Filtration

Sand and water do not mix, and they can be separated by filtration. During filtration the sand remains in the filter paper while the water will pass through it.
Water can be evaporated from the sand by heat to remove it completely.

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Conclusion

- Separation of mixtures is important for our daily lives.
- Guar and guayule produce compounds that are essential for the food, pharmaceutical, cosmetic, biofuel, and tire industries.
- Separated compounds from guar seeds include guar gum and phenolic compounds.
- Separated compounds from guayule include rubber, latex, and resins.
- These compounds can be extracted from the plant tissues and separated from other plant compounds by TLC, HPLC, and centrifugation.

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Laura Rodriguez-Uribe received a B.S in Biology from Universidad Autónoma del Estado de Morelos, Mexico. She received an M.S. in Biology and a Ph.D. in Molecular Biology from New Mexico State University. Before moving to NMSU, she worked for ten years at the Nitrogen Fixation Research Center and the Biotechnology Institute from the National Autonomous University of Mexico (UNAM) Cuernavaca, Mexico. Dr. Rodriguez-Uribe possesses more than thirty years of research experience, her research interests include plant molecular response to biotic and abiotic stresses, secondary plant metabolism, plant biotechnology, plant bioactive compounds, medicinal plants' chemistry, plant nutraceuticals, and functional foods development. She joined the SBAR team in October 2018 as a Research and Education Specialist and has worked with the Characterization & Co-Products and the SBAR Youth Development and Education/Extension & Outreach teams, developing curriculum with STEM-related activities for youth.

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