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Development and Characterization of a Gluten-Free Snack for People with Celiac Disease using Plantain Flour

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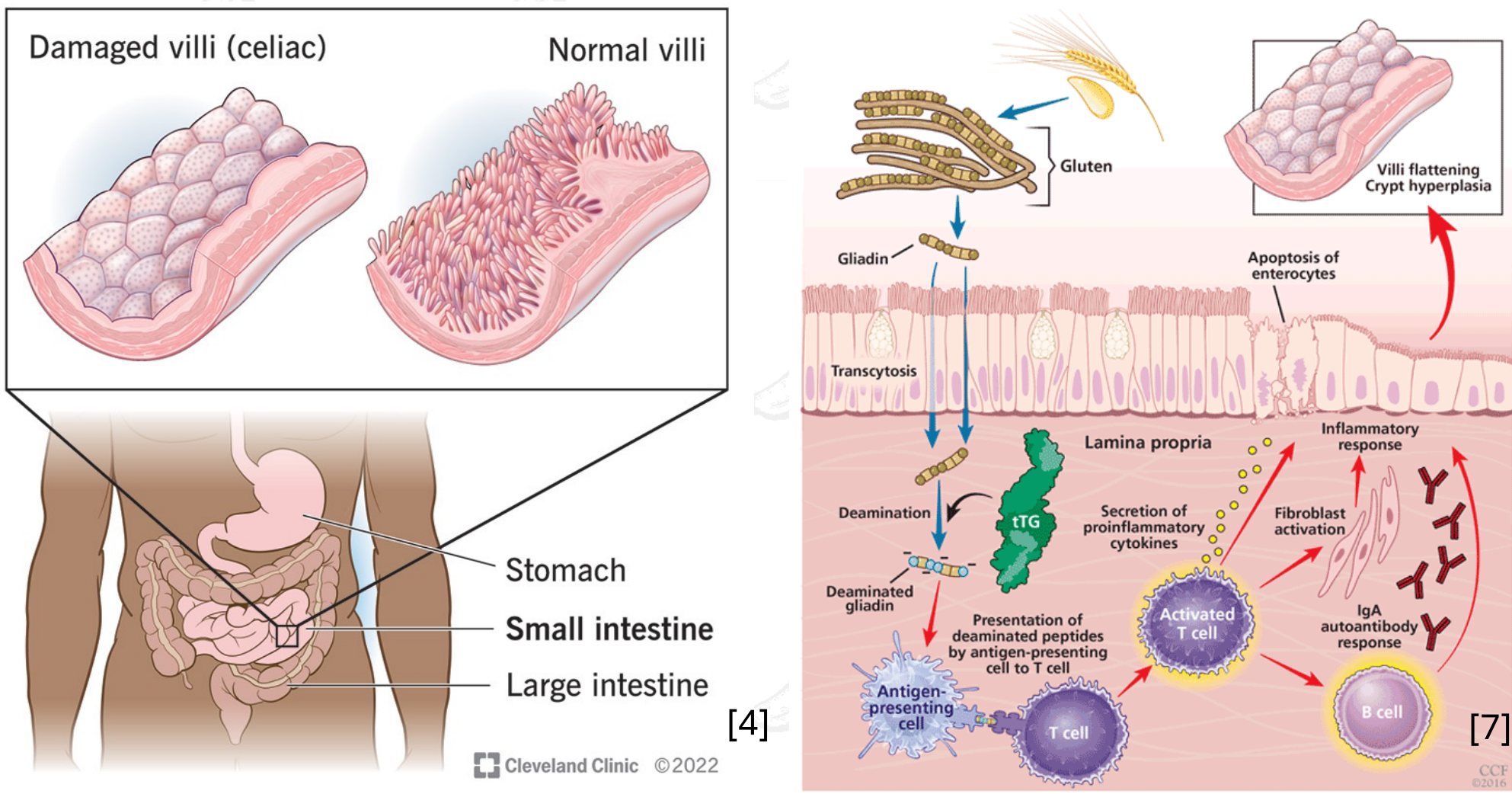
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Introduction

Celiac disease (CD) is an autoimmune disorder triggered by gluten, which damages the small intestine's villi^[8]. The two-signal model of T-cell activation hypothetically explains the pathogenesis of this disease^[1], involving a reaction in the intestinal mucosa and lamina propria after consuming gluten^[10]. A person with celiac disease needs to consume 10 to 50 mg of gluten to develop CD symptoms^[5, 3]. The immune response generates antibodies that serve as markers within CD detection^[14]. A gluten-free diet is the best treatment for this disease^[5], as no medical treatment can prevent mucosal damage from gluten^[12].

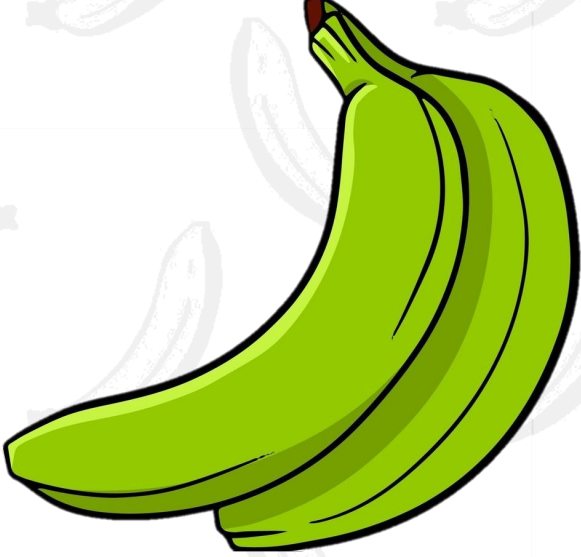
Celiac disease pathogenesis



It is estimated that “at least 1% of the world’s population is affected by CD”^[2]. Hence, a growing necessity for gluten-free products are need with special considerations^[6]:

- Avoidance of gluten-containing sources
- Alternate sources
- Ensure sensory characteristics
- Nutritional value and RDA requirements
- Reasonable prices
- Compliance with FDA guidelines

Methodology

2nd most consumed in Panama ^[9]  16 kg consumption per capita ^[11]

Plantain Flour

- Plantains were peeled and cut into 0.5 cm-wide slices.
- The slices were submerged in a citric and ascorbic acid solution to prevent oxidation.
- The slices were dehydrated for 6 hours at 125°C and ground into flour.

Product Prototype

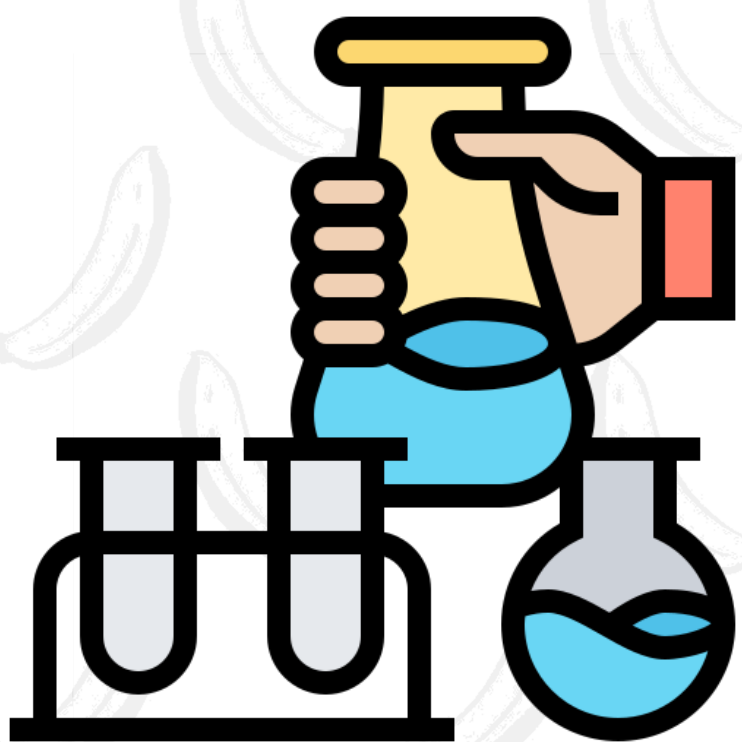
- Gluten-containing product was made of wheat flour. Gluten-free prototype was made of plantain flour. Both products have eggs, sugar, salt.
- The cookies were cooked in a convention oven for 10 minutes at 150°C.



Bromatology Analysis

AOAC Methods for bromatology assesment:

- Ash content
- Moisture content
- Crude fat
- Protein content
- Total carbohydrates
- Total dietary fiber



[15]

Results

Flour analysis

Parameter	Wheat flour ^[13]	Plantain flour
Ash content (%)	0.47	2.40 ± 0.06
Moistore content (%)	11.90	8.84 ± 1.31
Protein content (%)	10.30	2.01 ± 0.32
Total carbohydrates (%)	76.30	4.11 ± 0.59
Dietary fiber (%)	2.70	15.18 ± 0.96

Prototype analysis

Parameter	GC snack	GF snack
Ash content (%)	N/A	1.63 ± 0.02
Moistore content (%)	N/A	3.59 ± 0.01
Crude fat(%)	N/A	25.15 ± 1.41
Protein content (%)	6.54 ± 0.68	2.70 ± 0.07
Total carbohydrates (%)	12.29 ± 0.10	10.33 ± 2.86

N/A: not analyzed GC: gluten-containing GF: gluten free

- The gluten-containing cookie had more protein than the gluten-free cookie, as wheat flour contains more protein than plantain flour.
- High-protein ingredients, such as isolated soy protein, can enhance the protein content in this kind of product.

Conclusions

- As celiac disease rises and no treatment exists, a gluten-free diet is essential. Food manufacturers can provide nutritious, palatable, and affordable gluten-free products; they are required to know about food science disciplines and ingredients functionality.
- The developed GC and GF products should be tested with consumers to compare their sensory characteristics. Sensory testing of the gluten-free prototype by celiac people can determine its level of acceptance.

References

