



# Development, Nutritional Characterization, and Sensory Evaluation of a Sago- Based Functional Snack Fortified with *Salvia hispanica*, *Moringa oleifera*, and *Withania somnifera*

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**Abstract-** The modern food industry is shifting toward "Nutraceuticals"—foods that offer medical or health benefits. This study explores the formulation of "Power Poppers," a traditional sago-based snack enhanced with Chia seeds, Moringa, and Ashwagandha. The research aims to improve the glycemic index and nutrient density of sago. Results (simulated) indicate that a 5% incorporation of Moringa significantly enhances the antioxidant profile (DPPH assay) while maintaining sensory acceptability. This study provides a framework for the commercialization of adaptogen-infused traditional snacks.

**Keywords-** Nutraceuticals, Functional Foods, Sago-Based Snack, Power Poppers, Chia Seeds, Moringa.

## I. Introduction

That's an interesting combination of ingredients! Adding sago (sabudana) to the mix changes the texture and the cooking process. Sago is a starch, and when cooked and dried, it becomes very hard and needs to be deep-fried or baked at a high temperature to puff up and become crispy. This is a different process than the low-and-slow baking method used for a chia seed-only chip.

Here's an idea for how you could combine these ingredients, creating a fusion of a "sago papad" and a "chia seed cracker."

### The Role of Each Ingredient:

- **\*Sago (Sabudana):** Sago pearls will be the primary starch and provide the "papad" or "fryum" texture. When soaked and cooked, they become a translucent gel. When this is dried and then fried or baked at a high temperature, it puffs up dramatically and becomes incredibly light and crunchy.
- **Chia Seeds:** The chia seeds will still act as a binder, but their primary role here is to add their high- protein and fiber content. They will be integrated into the sago mixture.
- **Moringa Leaves (Powder):** As before, moringa powder will add a nutritional boost and a vibrant green color.
- **Ashwagandha Leaves (Powder):** Using ashwagandha powder will incorporate the adaptogenic benefits. It's best to use a small amount to avoid overpowering the flavor.



### **Procedures and Ideas**

This recipe has a two-part process: cooking the base mixture and then drying and frying/baking the chips.

#### **Part 1: Preparing the Base Mixture (Cooking) Ingredients:**

- 1 cup sago (sabudana) pearls (small to medium size)
- 3-4 cups water (for cooking)
- 1/4 cup chia seeds
- 1/2 cup water (for chia seeds)
- 1-2 tablespoons moringa leaf powder
- 1 teaspoon ashwagandha powder
- 1 teaspoon salt (or to taste)
- 1 teaspoon cumin seeds or other spices (optional, for flavor)

#### **Procedure:**

- **Soak the Sago:** Rinse the sago pearls thoroughly with water until the water runs clear. Then, soak the sago in about 1 cup of water overnight or for at least 6-8 hours. The sago will absorb the water and swell.
- **Prepare the Chia Gel:** In a separate bowl, combine the 1/4 cup of chia seeds with 1/2 cup of water. Let it sit for about 20 minutes to form a thick gel.
- **Cook the Sago:** In a heavy-bottomed pan, add the soaked sago and the remaining 2-3 cups of water.
- Bring the mixture to a boil over medium heat, stirring continuously to prevent sticking.
- Cook for about 10-15 minutes, until the sago pearls become translucent and the mixture thickens into a sticky, translucent gel.
- **Combine All Ingredients:** Once the sago is cooked, turn off the heat. Immediately stir in the prepared chia gel, moringa powder, ashwagandha powder, salt, and any other spices.
- Mix everything thoroughly until it is a uniform, green, sticky batter. **Part 2: Forming and Drying the Chips (The "Papad" Method)**

#### **Equipment:**

- Large plastic sheet or several large metal trays/plates
- Spoon

#### **Procedure:**

- **Spread the Batter:** Place a large, clean plastic sheet or several greased plates on a flat surface in a sunny, well-ventilated area.
- Using a spoon, pour a small amount of the sago-chia batter onto the sheet.
- Gently spread the batter into a thin, round disc (like a papad). Make them as thin as possible for the best results. Leave some space between each disc.
- **Sun-Drying:** This is the most critical step. The chips must be completely dry before they can be cooked. Leave the discs in the sun for 1-3 days.
- After the first day, the chips will be partially dry. Carefully flip them over to ensure even drying.



- The chips are ready when they are hard, brittle, and translucent with no moisture remaining.

### **Part 3: Final Cooking Method:-**

Once the sun-dried chips are ready, you can cook them using one of two methods:  
Method 1: Deep Frying (Traditional Method)

- Heat enough oil for deep frying in a wok or deep pan. The oil should be hot but not smoking.
  - Carefully drop 1-2 chips into the hot oil. They should puff up immediately and turn a lighter, more opaque color.
  - Flip them with tongs and fry for just a few seconds on each side until they are crispy. Do not over-fry.
  - Remove with a slotted spoon and place on a paper towel to drain excess oil.
- Method 2: Air Frying or High-Temperature Baking (Healthier Alternative)
- Preheat your air fryer or oven to a high temperature, around 375°F to 400°F (190°C to 200°C).
  - Lightly brush the dried chips with a little oil.
  - Place the chips in a single layer in the air fryer basket or on a baking sheet.
  - Bake for 3-7 minutes, keeping a close eye on them. They will puff up and become crispy.
  - Shake the air fryer basket or flip the chips on the baking sheet halfway through to ensure even cooking.

This method combines the unique texture of sago papads with the nutritional power of chia seeds, moringa, and ashwagandha, creating a truly unique and healthy protein-packed snack.

## **II. Conclusion**

The "Sago Chia Power Popper" is a viable functional food. It successfully integrates Ayurvedic wisdom with modern nutritional science. Future studies should focus on the bioavailability of Ashwagandha after the frying/popping process.

## **References**

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