CHEMISTRY OF MOONCAKES
A STAPLE OF MID AUTUMN FESTIVAL

RECIPE INGREDIENTS

For the Dough
- 8.75 tablespoons sugar syrup
- 1/3 cup peanut oil or corn oil
- 1 teaspoon lye water
- 1 3/4 cups flour

For Assembling and Baking
- Prebought lotus filling
- 18 salted duck egg yolks
- 1 egg yolk
- 3 tablespoons water
- Mooncake Mold

RECIPE PART 1
THE DOUGH

Begin by combining sugar syrup, oil, and lye water. Incorporate this mixture into the flour, using a rubber spatula to fold and blend until a soft dough forms. Cover the dough with an airtight container and refrigerate for 1 hour.

RECIPE PART 2
ASSEMBLING

1. Measure out eighteen portions of lotus filling, each weighing 58 grams. Form each portion into a ball. Proceed by taking a 58-gram lotus ball, creating a deep well in the center, and placing a salted duck egg yolk inside. Seal the top and reshape it into a ball. Repeat this process for the remaining 17 pieces.
2. Separate the dough into eighteen portions, each weighing 25 grams. Form each piece into a ball and lightly dust the dough balls with flour.
3. Take a dough ball, sprinkle it lightly with flour, and roll it out on a floured surface into a 4-inch/10 cm round. Place a portion of filling in the center. Lift it carefully, turn it upside down, and gently press out air bubbles around the lotus ball without damaging the dough. Now, turn the opening facing up and slowly press the dough together to seal it.
4. Now lightly dust the assembled ball with additional flour. Place it inside the mooncake mold. Place the mooncakes on a baking sheet after the dough gets molded. Repeat until you’ve assembled all 18 mooncakes.

RECIPE PART 3
BAKING

1. Preheat the oven to 325°F/160°C
2. Put the mooncakes in the oven and bake for 5 minutes.
3. Create the egg wash by whisking together the egg yolk and water.
4. After 5 minutes, remove the mooncakes from the oven and promptly reduce the oven temperature to 300°F/150°C.
5. Gently brush each mooncake with the egg wash and return them to the oven. Continue baking for an additional 15 minutes.
LYE WATER

MAillard Reaction

The most crucial chemical reaction contributing to mooncakes' unique structure, texture, and taste is the Maillard Reaction. Found in nearly every baked good, this reaction provides the crusting of the outside layer and the golden-browning effect of the crust that we know and love. The Maillard Reaction involves the reduction of carbonyl on a sugar by an amino group of an amino acid, the building block of proteins. In this scenario, the amino group acts as the nucleophile, donating its electrons to initiate the reaction and form the first bond and a high-energy glucosamine intermediate.

After the unfavored glycoamine is formed, it is quickly turned into a derivate of amino deoxy fructose through an Amadori rearrangement.

This 5 carbon ring is then finally through a series of steps converted to many different flavors and aromas, including the dark-colored product melanoidins that give the mooncake its brown appearance. Overall this process converts a relatively simpled linear sugar into a ringed carbohydrate and a plethora of aromatic compounds and flavors.

LYE WATER

This recipe for mooncake, along with many other traditional Asian recipes, calls for the use of Lye Water, an alkaline solution of potassium oxide KOH or potassium carbonate. This alkaline solution often diluted with water is used to accelerate the Maillard Reaction, lowering the temperature requirements and keeping the dough soft. This is because alkaline conditions can deprotonate the amino group in the reaction (RNH+3\text{→}RNH2), enabling it to act as a much better nucleophile, lowering the kinetic barrier to product formation. Lye water also gives Chinese recipes their unique taste and chewy texture. Its chemical properties are very similar to Baking Soda but are especially important in Asian recipes involving the Maillard Reaction.

Lye water raises pH and favors the reduction reaction by increasing the nucleophilicity of the amine group through deprotonation. Nitrogen is deprotonated because the pH is higher than the pKa of the amino group (~10). The lone pairs of the resulting depronated nitrogen (NH2) make it a better electron donator.

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\begin{align*}
\text{At low pH} \quad & \quad R-C=O \quad \text{H}^{+} \\
\quad & \quad R\text{-NH}_{3}^{+} \\
\text{At neutral pH} \quad & \quad R-C=O \\
\quad & \quad R\text{-NH}_{2} \\
\text{At high pH} \quad & \quad R-C=O \\
\quad & \quad \text{NH}_{3} \\
\end{align*}
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References


