How to cook a *TORTILLA de PATATA*
(A scientific approach)

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1 Motivation.

In Spain it is well known that *Tortilla de Patata* is one great food. It is cheap, easy to cook and tasty. But unfortunately this food is barely known outside the spanish borders. This document tries to spread the knowledge of this great dish. We aren't supposed to be so selfish to keep this mankind-gift recipe as an classified spanish secret.

2 What we need before we start.

This is a recipe to cook one normalized-size tortilla. (1 t.u. = 1 tortilla units). This "de-facto" unit is not yet recognized by international standards, but we hope some day it will be.

Ingredients for 1 t.u.:

* al. is the most referenced second author ever. (I hope his contribution help us to pass all those stupid referees)

1. Potatoes. The number depends on the average potato size. The mathematical treatment of the potato body shape is rather difficult, so let us assume the potato is a perfect cube with a edge length of L = 5cm.([1]) In this case 4 cubic potatoes are needed for 1 t.u. tortilla.

2. Onion. In this case a spherical approximation is good enough. As a general rule the onion diameter for 1 t.u. must be the same as the cubic potato edge, but this value is not critical. Variations as high as 50% are allowed in the onion diameter without great tortilla performance degradation. Only one onion is required. If the actual onion is too big we can use only a portion of it.

3. Eggs. The eggs are a quantized entity by nature, so an integer number of eggs are needed. (Don't try to use a fractional egg part. It can be nasty). 1 t.u. requires 4 eggs. Recently, due to low-fat fashion, a 3 eggs/t.u. is also becoming popular, but the egg reduction creates a substantial degradation of the tortilla quality.

4. Oil. Olive oil is strongly recommended. While other oils can be used in order to reduce costs, the tortilla quality is clearly inferior. 25 $cm^3$of oil can be enough. More oil can be used during the cooking and the excess can be recycled.

5. Salt. 1 to 2 cm^3 of sodium-chloride are enough. Other chlorides like potassium-chloride are potentially good but they aren't yet tested. It is not clear what is the optimum salt dose, so some experimentation must be done to find this quantity.

Tools needed to cook the tortilla:

1. Mandatory:

   (a) A frying pan. The diameter must be 25 to 30 cm. A teflon coated pan is strongly recommended.

   (b) Several dishes. One dish must exceed the frying pan diameter because it will be used to flip the tortilla (see figure 1).

   (c) One bowl. It will be used as the main mixing container. It must be big enough to hold all the ingredients and still allow space for stirring.

   (d) Knife, fork.

2. Optional:

   (a) A blender. It can be used to stir the eggs.

3 Cooking Procedure.

3.1 Phase A:

1. Peel the potatoes and onion.

[1] 1 inch = 2.54 cm

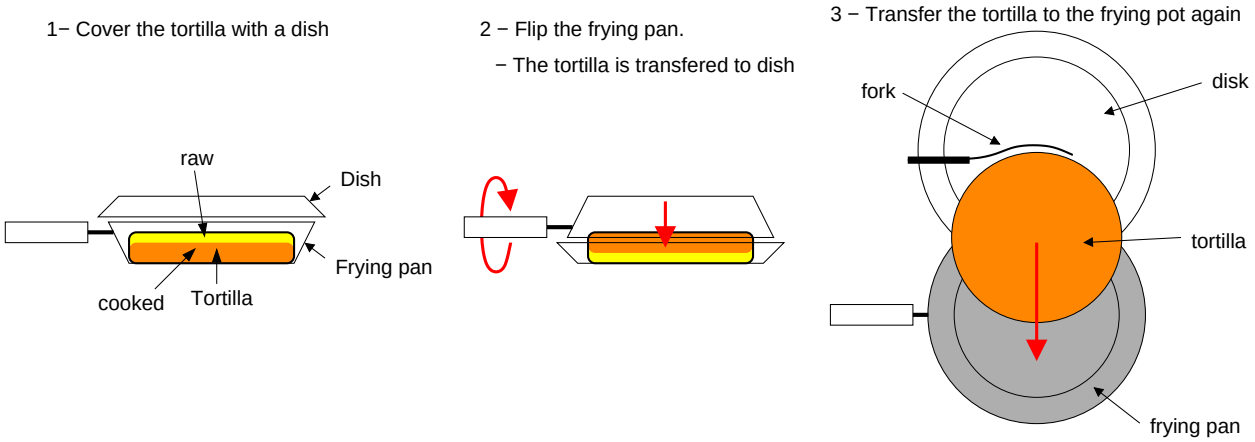

Figure 1: Procedure to flip the tortilla safely.

2. Cut the potatoes and onion into a small cubes. The optimal cube edge length is about 7.5 mm([2]) but lengths ranging from 5 mm to 10 mm (=1cm) are also good enough. Cutting the onion is somewhat sad. Some people want to cry while doing this task. Don't worry: it is normal.

3. Put the potato and onion dice in the frying pan with oil and salt. Raise the pan temperature to about 423K. ([3]) Keep frying the potatoes and onion until they become soft. The softness is tested trying to crush a test potato die with the fork. If more than 800 KPascal ([4]) of fork pressure are needed to crush the test potato more frying is still needed. While frying a temperature gradient is established across the potato and onion dice. In order to get an uniform frying the dice must be moved from top to bottom places in the frying pan every 20 to 30 seconds.

4. Once frying is complete the dice are crushed with the fork, and the excess oil is removed. This oil can be used for future tortillas. Olive oil can be used several times without much degradation. On the other hand, the repeated use of low quality frying oil, like corn or sunflower oil, can generate carcinogen molecules like "benzopyrene".

5. Put the eggs in the bowl and blend them. This can be done manually, with a fork, or with the aid of some electric blender. A uniform yellow liquid are obtained after this step.

6. Mix the fried potatoes and onion with the blended eggs. Use a fork to accomplish this point.

3.2 Phase B.

1. Heat up the frying pan to about 413 K. Add only some drops of oil if needed. Probably, if the frying pan is the same of the phase A, no extra oil is needed at all.

2. Put the potato, onion, and eggs mixture into the frying pan. Spread it using a fork until a uniform level if obtained.

3. Keep frying at low temperature, and be sure that the tortilla don't stick to the pan. To avoid tortilla sticking the frying pan must be shaken in a circular fashion, using the tortilla inertia as the main un-sticking force.

[2] 1 inch = 25.4 mm
[3] To avoid confusion between Celsius and Fahrenheit degrees all the temperatures will be given in Kelvin.
[4] 1 psi = 7750 Pascals

4. The frying temperature triggers a chemical reaction (protein polymer synthesis) in the tortilla that makes it to become solid. After a few minutes of frying, typically 3 to 5, one tortilla side is enough cooked, but the other is still raw. This is the time for the most critical part of the tortilla cooking: The *TORTILLA FLIPPING*. Using the big dish as depicted in figure 1 the tortilla is flipped upside-down. Professional cooks will try to flip the tortilla in the air. In that case it is recommended for all other people in the kitchen to wear helmets and take cover.
5. Keep frying the second tortilla side for a few minutes. Then use the same steps 1 & 2 of the tortilla flipping procedure (figure 1) to transfer the tortilla to the final dish destination.
6. Wait until the tortilla cool down.

4 Conclusions.

After the tortilla is made the best thing we can do is to conclude eating it. Tortilla is also good as a cold food. But eat it through the day it is made. Otherwise it can become contaminated with dangerous microorganism like “salmonella”. This is a good rule for any food made with eggs if you don’t want to end in a hospital.

In summary:

- A standardized procedure for tortilla cooking is presented.
- In this procedure physical magnitudes are quantified and measured in standard units. No ambiguous terms like “dente” are used. Magnitude ranges are also presented, so statistical variations are allowed to some extent. We hope this experiment can be repeated across the World without problems.
- We wanted to present some experimental data, but we ate it.

5 Acknowledgments

Here is an unfinished list of people that contributed to this work. We want to show our gratitude to:

- al., the second author.
- The Chicken for providing the eggs for the experiments.
- Cristobal Columbus for the America’s discovery that brought potatoes to Spain where its great value as main tortilla ingredient was quickly discovered.
- The unknown *Homo-erectus* man that discovered the fire.
- TEX, LATEX and LYX authors for the editing tool.

6 Bibliography.

To our knowledge we are the first authors that tried to treat this subject in an scientific manner. All the books we read about it were written in a semi-magical language that does not deserve a reference in a serious paper like this. Therefore, we think we are the first to write a cornerstone paper about a too much important subject and can’t reference any prior author.