To obtain a bread, a baguette airier and more honeycombed

**Background and objective**

The objective is to obtain a baguette airier and more honeycombed.

A baker who owns many bakeries wants to improve the taste characteristics and the texture of his bread, so that it would be lifter, more honeycombed and less compact.

The state of the crumb now is because of the lack of time of first fermentation and second fermentation due to the configuration of the line.
The baguette that the Seeker produces nowadays:

The top picture (with two pieces): the bread is enough honeycombed.

The bottom picture (single piece): the bread below shows the compact area that is not honeycombed enough.

For compensating the lack of time of first fermentation and second fermentation, the current settings are as below:

<table>
<thead>
<tr>
<th></th>
<th>Current setting for weakening the problem of the lack of second-fermentation time</th>
<th>habitually</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydration of the doughs</td>
<td>70%</td>
<td>75%</td>
</tr>
<tr>
<td>Yeast</td>
<td>15g/l (for the dough lifts a minimum as it enters the oven)</td>
<td>5-10g/l</td>
</tr>
<tr>
<td>Time of the first fermentation (h) (1)</td>
<td>1.5 h</td>
<td>4-6h</td>
</tr>
<tr>
<td>Time of the second fermentation (h) (2)</td>
<td>0</td>
<td>1h</td>
</tr>
</tbody>
</table>

(1) The time of the first fermentation (rest time) is the first time of fermentation. Highly first-fermented dough makes the bread generate the irregular honeycombs in the crumb. This is the first period of dough fermentation between kneading and weighing. The first fermentation is done in mass in a kneading tank. Its first role is to give strength to the dough. It corresponds to a first modification of the dough for a better gas retention. The second role is to promote alcoholic fermentation for the development of aromas and the increase of the acidity of the dough thanks to the multiplication of ferments. Its various duration according to the method and the work and the type of fermentation chosen.

(2) The time of second fermentation is mainly concerns the production of CO2 (which will cause the baguette to swell in the oven). Due to the technical constraints of the line and the building, the second-fermentation time must remain at 0. This is a major fermentation phase that begins after shaping and ends with baking when the temperature reaches 50°C (destroyed yeast). It is done either on plates or trolleys at room temperature or in a cabinet / fermentation chamber. Its purpose is the production and retention of gas to obtain volume. The dough begins to have a honeycomb structure. The various duration of the second fermentation according to the chosen working method.

The various duration of the second fermentation according to:

- Kneading methods
  - The duration of the second fermentation is proportional to the intensity of the kneading, which partly determines the structure of the gluten network and therefore the tolerance of the dough.
    - Type of kneading Duration of the primer
    - PVL 600 brews From 0 h 45 to 1 h 15
- PA 1200 brews From 1 h 30 to 2 h 00
- PI 1800 brews From 2 h 00 to 3 h 00

- Bread-making methods
  - The duration of the second fermentation is inversely proportional to the amount of yeast or fermentation agent. The higher the yeast dose, the shorter the duration of this fermentation.

- The temperature and consistency of the dough have an influence on this fermentation period
  - This influences the activity of the yeast. The higher the temperature of the dough, the more active the yeast is and therefore the duration of the second fermentation decreases.
  - Generally, a firm dough requires a longer time for second fermentation because fermentation is less active, and the gluten network is more resistant to gas thrust.

- The nature of flour
  - The duration of the second fermentation is influenced by the enzymatic power of the flour, which varies mainly according to the wheat crops and the storage conditions of the wheat.
  - A surplus of enzymes accelerates amylolysis and therefore fermentation.

- The environment
  - The activity of the yeast is sensitive to humidity and ambient temperature, so the duration is prolonged in a cool and dry environment.

The question is how to increase the time of first fermentation which is necessary for developing the alcohols for better taste and how to make the baguette develops more in order to obtain a very greasy and honeycombed crumb.

Two important points: improve the first-fermentation time and the development of the baguette.

Description of the line
- Tanks of the mixtures are made
- Kneading machine
- first fermentation area
- Then the line with different steps
  - Extruder
    - The dough is already very "tight", due to internal constraints
**Examples of the possible solutions:**

Possible solutions (non-exhaustive list):

- **Conditions**
  - Temperatures
    - Fermentation temperature
  - Dough hydration
- **Speeds**
  - Kneading
    - Oxygenation
  - Increase the time of first fermentation
  - Change the speed of the line
    - Mechanical modifications of the line
- **Additions**
  - The addition of natural yeasts
- **External area for second fermentation** (but at the risk of exceeding 200k €)
- **Methodology**
  - Scarification
The solution may be multifactorial

**Existing solutions – solutions that has been tested without success**

Several tracks had been investigated without success:

Ideally, a solution with an additional 15 metres of production line could be the best solution, but this is not possible at this stage due to the constraints of the building.

Several solutions to install a zone of second fermentation have been considered:

- At the beginning of the line, there are few meters that could used in the storage areas, but the available length is too small to have a second-fermentation zone.
- Before the oven, we have done a study about extending the length of a linear extension had been considered, but the cost is prohibitive.
- A solution with a high-rise storage area was also considered, but this seems impossible due to the low volume and especially economic constraints (€1M).

Unfortunately, the solution of adding a zone for second fermentation seems impossible (unless an innovative solution that has not been considered).

Below is a stylized view of the line; at the top is the oven, at the bottom, green is the tank elevator, blue is the production line.

Many parameter changes, line settings, has been tested (with only one modification at a time).

**Technical Contraints :**

The proposed solution must respect several constraints:

**Traditional French bread**

- Using traditional French flour
- No preservatives
- No additives

**Economic Contraints :**

The proposed solution must respect several economic constraints:
- Production time increased by less than 30%.
- Invest less than €200k

**Reward:**
For solutions that respect all the above-mentioned elements (except for the investment), and allow to increase the cells by 250% (the way of measurement? Comparison of the 2 photos).

<table>
<thead>
<tr>
<th>Investment Range</th>
<th>Theoretic Solution (2)</th>
<th>Solution successfully tested (1) (2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>The investment is less than 50k€</td>
<td>10 000€</td>
<td>20 000€</td>
</tr>
<tr>
<td>The investment between €50k and €200k</td>
<td>5 000€</td>
<td>10 000€</td>
</tr>
<tr>
<td>The investment between 200k€ and 300k€.</td>
<td>3 000€</td>
<td>6 000€</td>
</tr>
<tr>
<td>The investment of more than 300k€.</td>
<td>1 500€</td>
<td>3 000€</td>
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</tbody>
</table>

(1) The solution has been the subject of a study demonstrating the possibility of industrial exploitation within the stated constraints or by means of a prototype. Your proposal should demonstrate the effectiveness of the solution. An effectiveness report and/or publication on the issue will be required from the Solver.

(2) *If the production time is increased by less than 15%, a multiplier of 1.5 will be applied.*