Aims of the AD plant operator

- High and constant production
- Higher efficiency by using the products (yield)
- Lower costs
  - Optimization of the input material
  - Reasonable use of side-products
    - On farm
    - From market
Different contests, specific systems and many feeding opportunities
Indexes of biological efficiency

- Utilisation of the whole potential degradable organic matter
- Less energy expense necessary to maintain the microorganisms
- Higher concentration of CH$_4$/biogas
Efficiency/proposal for measurement

- Methane/potential fermentable organic matter (pFOM)
- pFOM fermented / pFOM added
Fodder composition

Fresh matter
  Water (humidity)

Dry matter

Anorganic substance (Ashes)
  Organisc matter (OM)

- Fermentable OM
  - Carbohydrates
  - Proteines
  - Fats

- Non fermentable OM
  - N fixed to fibre
  - Lignin
  - Fibre fixed to lignin
Knowing exactly the fodder composition

➢ Analysis in laboratory
  • Fast
  • Reliable
  • Precise

➢ Determination of all substrate components
  • Especially the fermentable and non fermentable quotes
Univerity of Bologna and BTS created a dynamic system:

- Bacterial development in the fermenter
- Kinetic degradation of all substrates
- Methane production
- Quantity and quality of the digestate
- Total efficiency of the fermentation process
Biomass under the microscope
BIOaccelerator

Structure of the cell

- Hemicellulose
- Cellulose
- Lignin

interior of the cell
Botanic composition

1: WHAT'S IN A PLANT?
A plant is not just a plant. It consists of many components. Here are the components of a corn plant. (All plants have the same components. The proportions differ from plant to plant.)

- **Starch:** 75%
- **Protein:** 9%
- **Hemicellulose:** 27.6%
- **Cellulose:** 37.4%
- **Lignin:** 18%
- **Ash/Nutrients:** 5.2%
- **Other:** 11.8%

65% of biomass is cellulose and hemicellulose.

Ingredients are returned to the soil as fertilizers.
Botanic composition
Cow Fistula

Fistula on the cow: fermentation samples directly from the rumen
A new method: Biogas fistula

- It is necessary to know the kinetic degradation of the organic matter in time

- Usually there are used pilot fermenters in laboratory
  - But it is impossible to describe the kinetic degradation

- Doubt about the reproducibility of what really happens in practice
Preparation of samples to be analysed in laboratory
A new method: Biogas fistula

Introduction of the samples into the biogas plant.

It’s possible to retrieve the bags at any time to analyse the non fermented matter.
• The first laboratory specialized in biogas in Italy
• More than 3,000 analyses of fermenters per month
  • pH, FOS/TAC
  • all kinds of acids
  • DM, oDM
  • N, Ammonium
  • Micronutrients
  • Electric conductivity
  • Redox potential
  • NDF, ADF, ADL
  • XP, starch, fat, sugar
BTS Biogas with University of Bologna
Dynamic forecast model for:

- Development of the bacterial grow
- Kinetics of degradation for every single substrate and the ration mix
- Production of methane/electric energy
- Quantity and Quality of the digestive product
- Global efficiency of the fermentation process
- Economical efficiency for the diet costs
Influence factors for the digestion:

- Retention time (TR)
  - Passing velocity (Kp)
- Constant of hourly degradation (Kd)
  - Intrinsic characteristics of the substrate
  - Treatment – exposed surface

Knowing Kp and Kd we can calculate the degraded substrate in the fermenter
Weende Method

Non fermentable matter

\( \text{pFOM} \) potentially fermentable organic matter

Own consumption of the bacteria

Potential residue gas

\( \text{FOM} \) fermented organic matter
### Plant Name:
workshop bts

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<thead>
<tr>
<th>V Hydrolyse [m3]:</th>
<th>Volume</th>
<th>Days</th>
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<td>Triticale Silage 30.5% DM media</td>
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<td>Wheat Bran average N°265</td>
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# Cost – optimization

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Calculation for the TMR

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<th>Component</th>
<th>Graph</th>
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<tr>
<td>Dry Matter</td>
<td><img src="image" alt="Graph" /></td>
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<tr>
<td>Raw Proteins</td>
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<tr>
<td>NDF</td>
<td><img src="image" alt="Graph" /></td>
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<tr>
<td>Starch</td>
<td><img src="image" alt="Graph" /></td>
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<tr>
<td>Sugar</td>
<td><img src="image" alt="Graph" /></td>
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<tr>
<td>Lipid Fat</td>
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Fermentable Mass

Organic DM

pFOM

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\begin{align*}
\text{org. DM / DM} \\
\text{pot. ferm.org. DM / DM} \\
\text{ferm.org. DM for CH4-Prod. / DM} \\
\text{ferm.org. DM for bac.gr. / DM} \\
\text{n.ferm. DM / DM}
\end{align*}
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\end{align*}
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Details of the degradation

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</table>

Products which are not enough degraded in the ration mix?
### Output

<table>
<thead>
<tr>
<th>Quantity</th>
<th>% of Total Quantity</th>
<th>% of Dry Matter</th>
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<tbody>
<tr>
<td>Quantity</td>
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<tr>
<td>Dry Matter</td>
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<td>Azote</td>
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<td>N ADIP</td>
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<tr>
<td>Lost N-NH4</td>
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<td>Total remaining N</td>
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<td>Ashes</td>
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<td>NDF</td>
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<td>Lignin</td>
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<tr>
<td>Remaining Bacteria</td>
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**Recirculation**

Yes / No?
### BIOaccelerator

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<th>Energy Content</th>
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<tbody>
<tr>
<td>Materiale grezzo</td>
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<tr>
<td><strong>Expected Energy / Day</strong></td>
<td>kWh</td>
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<tr>
<td><strong>Energy Target / Day</strong></td>
<td>kWh</td>
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<tr>
<td>ferm.org. DM for CH4-Prod / pot.fermb. org.DM</td>
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</table>
Thank you for your attention!

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I www.bts-biogas.com
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