

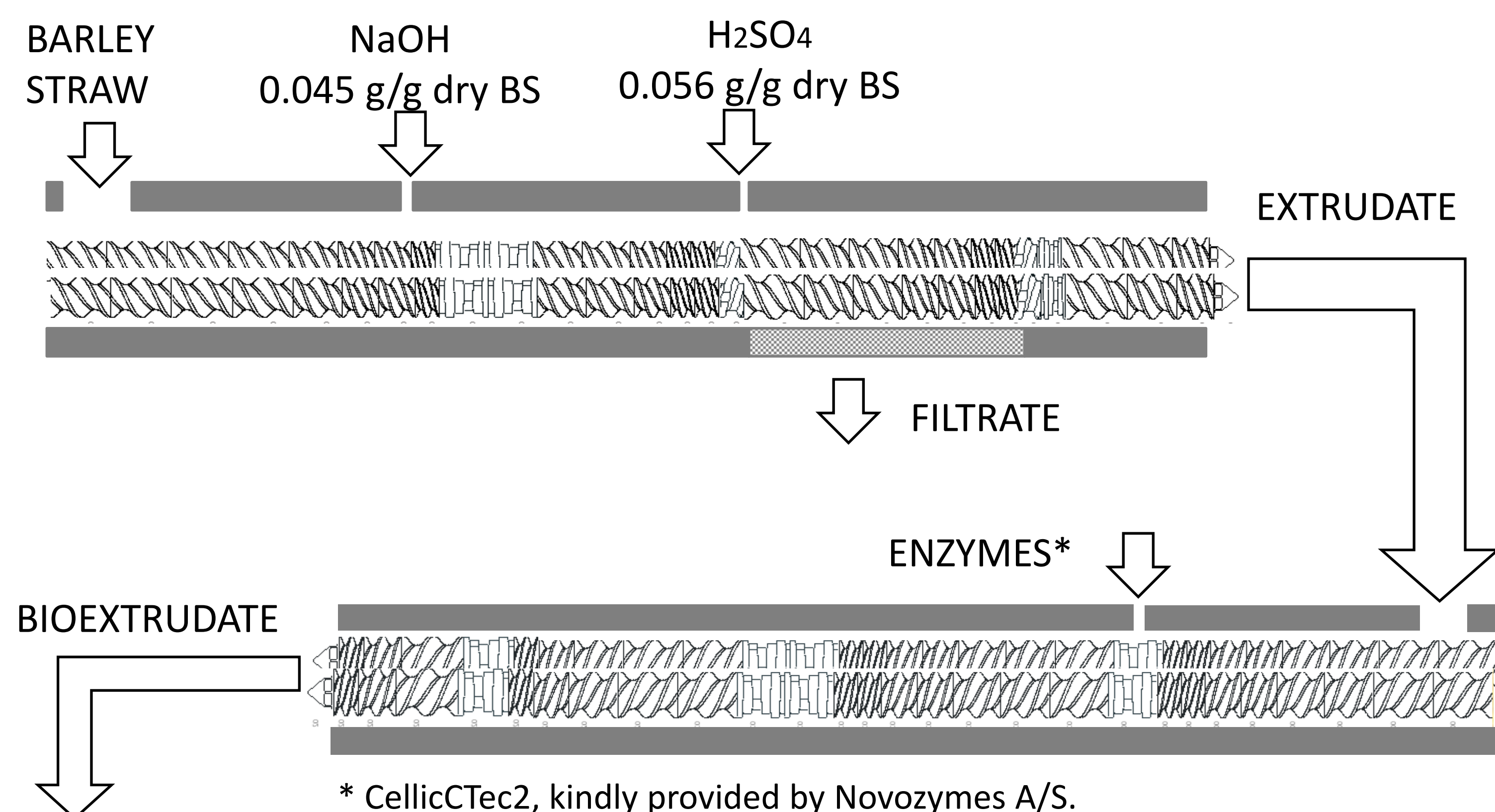
SUGAR PRODUCTION FROM BARLEY STRAW THROUGH AN INTEGRATED PRETREATMENT OF ALKALINE AND ENZYMATIC EXTRUSION

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Objective:

To study the sugar and ethanol production from integrated alkaline and biological extrusion of barley straw in different configurations.

Methodology:



B1 – 15 FPU/g dry extrudate & 33% (w/v) solids

B2 – 5 FPU/g dry extrudate & 20% (w/v) solids

Enzymatic hydrolysis (EH)



50°C
72h

Composition analysis

Determination of carbohydrates, lignin and ash.

Pre-hydrolysis (PH)



50°C
24h

Simultaneous Saccharification & Co-Fermentation (SSCF)



30°C
72h

1% vol. CelluX 4®

*Kindly provided by Lessafre

Conclusions:

- Alkaline extrusion of barley straw followed by bioextrusion with enzymes is an integrated process that releases sugars (mainly xylooligomers) and promotes the liquefaction of high solids loading substrates.
- Extended incubation of the bioextrudate 1 (B1) resulted in >100 g/l of monomeric glucose and xylose, whereas after incubation of bioextrudate 2 (B2) with lower enzyme and solids load <60 g/l were obtained. Under B2 conditions, less oligomers are produced during the incubation.
- Similar sugar yields (taking into account glucose and xylose) can be obtained by using a high enzyme dosage (15 FPU/g dry extrudate) at a high solids concentration (33% w/v) or a low enzyme dosage (5 FPU/g dry extrudate) and still a high solids load such as 20% w/v.
- CelluX4 efficiently ferments glucose and xylose to ethanol. All glucose is consumed within the first 24h after inoculation, whereas the depletion of xylose is slower and not complete after 96h of incubation. In the case of B2 the amount of xylose remaining is very small (<1.5 g/l), while under B1 conditions almost 10 g/l of xylose are left unfermented in the media.
- The ethanol yield of the whole process (using the theoretical conversion of glucose and xylose to ethanol) is close to 50% in both cases.

Results:

Figure 1– Glucose and xylose concentration in monomeric (m) and oligomeric (o) form after 0, 24, 48 and 72h of incubation of bioextrudate 1 (full columns) and bioextrudate 2 (striped columns). Glucose concentration includes glucose from the enzyme preparation.

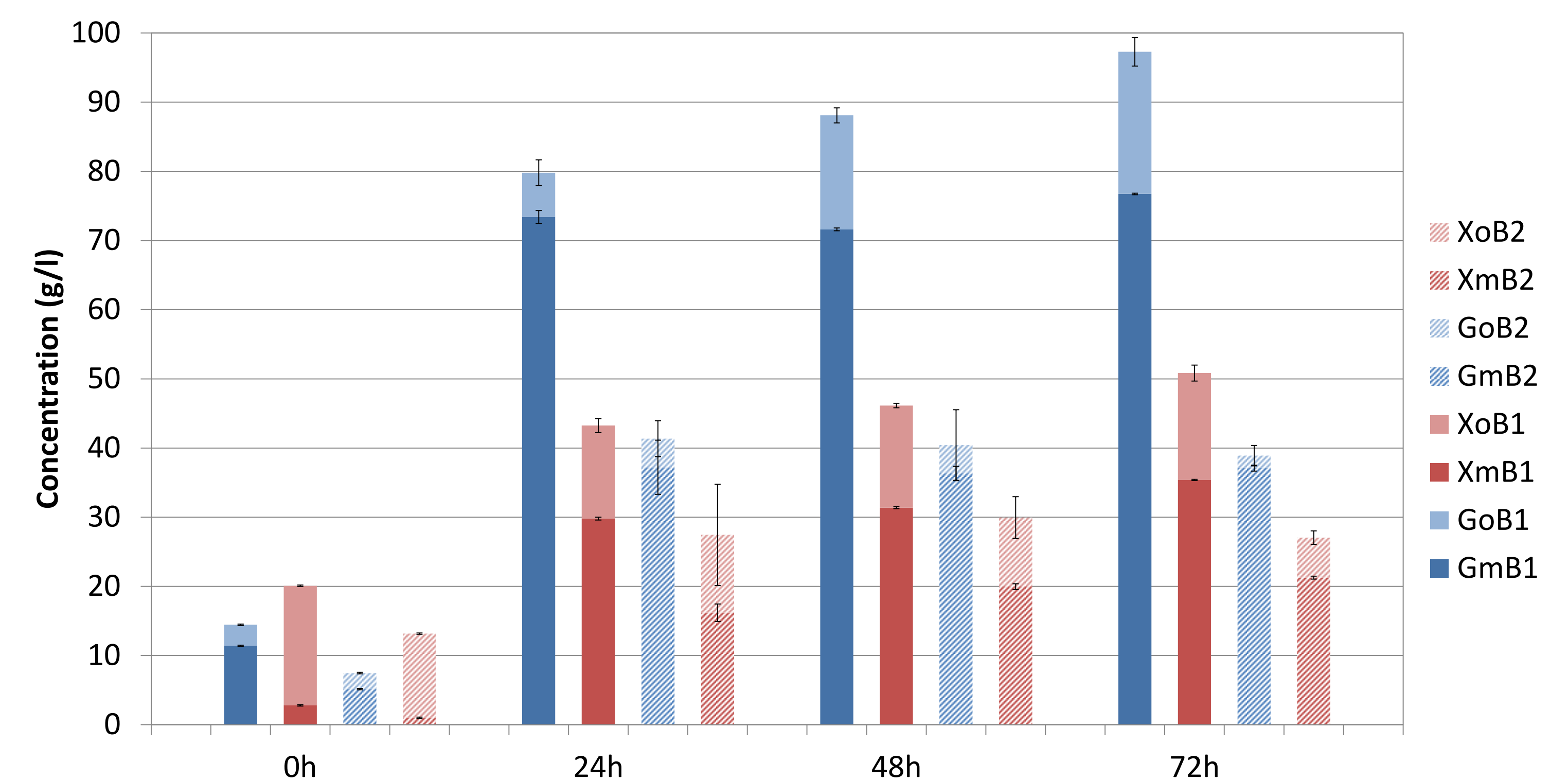


Figure 2– Sugar yield (referred to potential glucose and xylose) of bioextrudates 1 and 2 after 0, 24, 48 and 72h of incubation at 50°C.

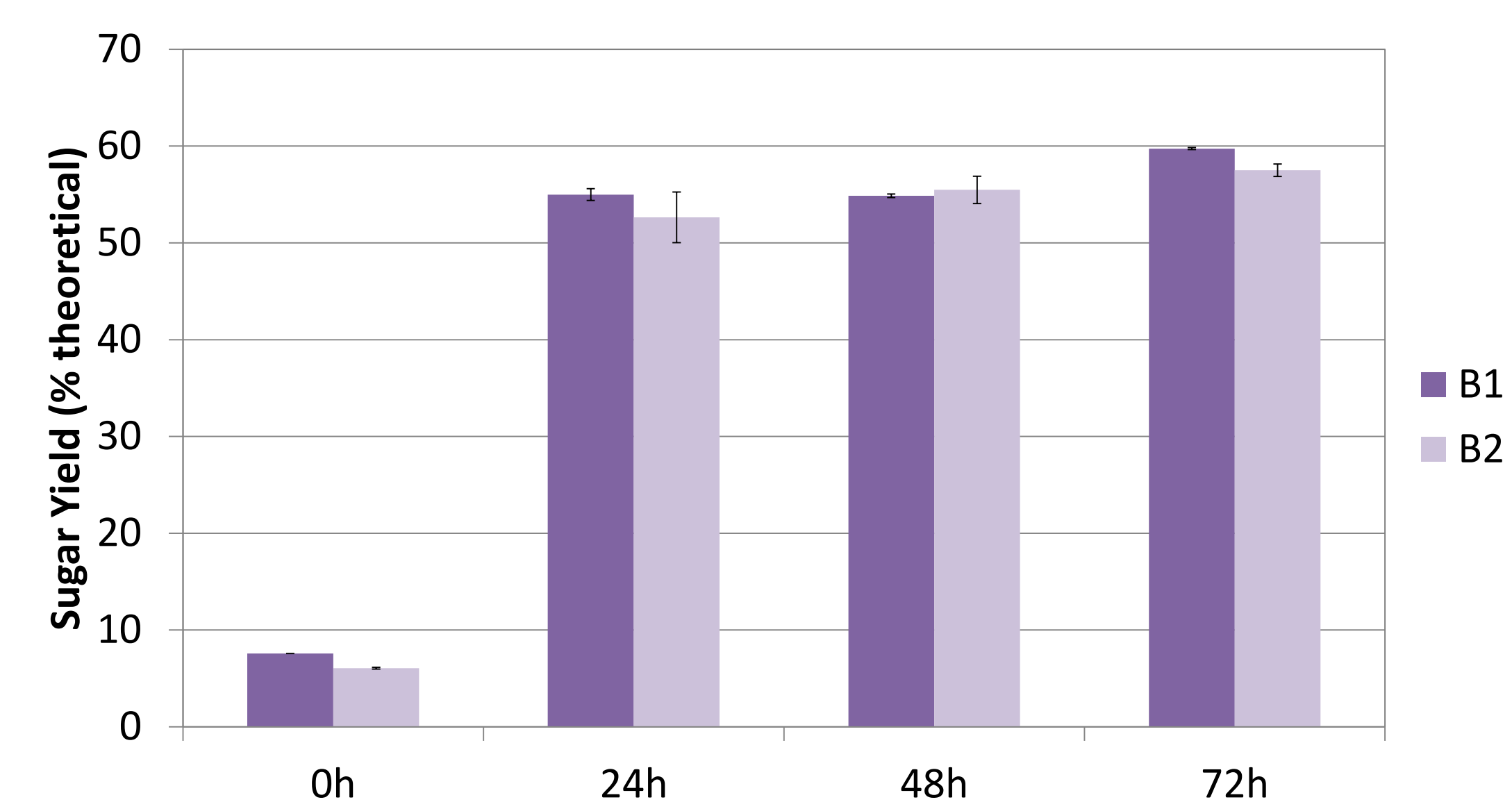


Figure 3– Glucose, xylose and ethanol concentration in the media, at 0, 24, 48, 72 and 96h of incubation of bioextrudates 1 (full line) and bioextrudate 2 (dotted line). Inoculation at 24h.

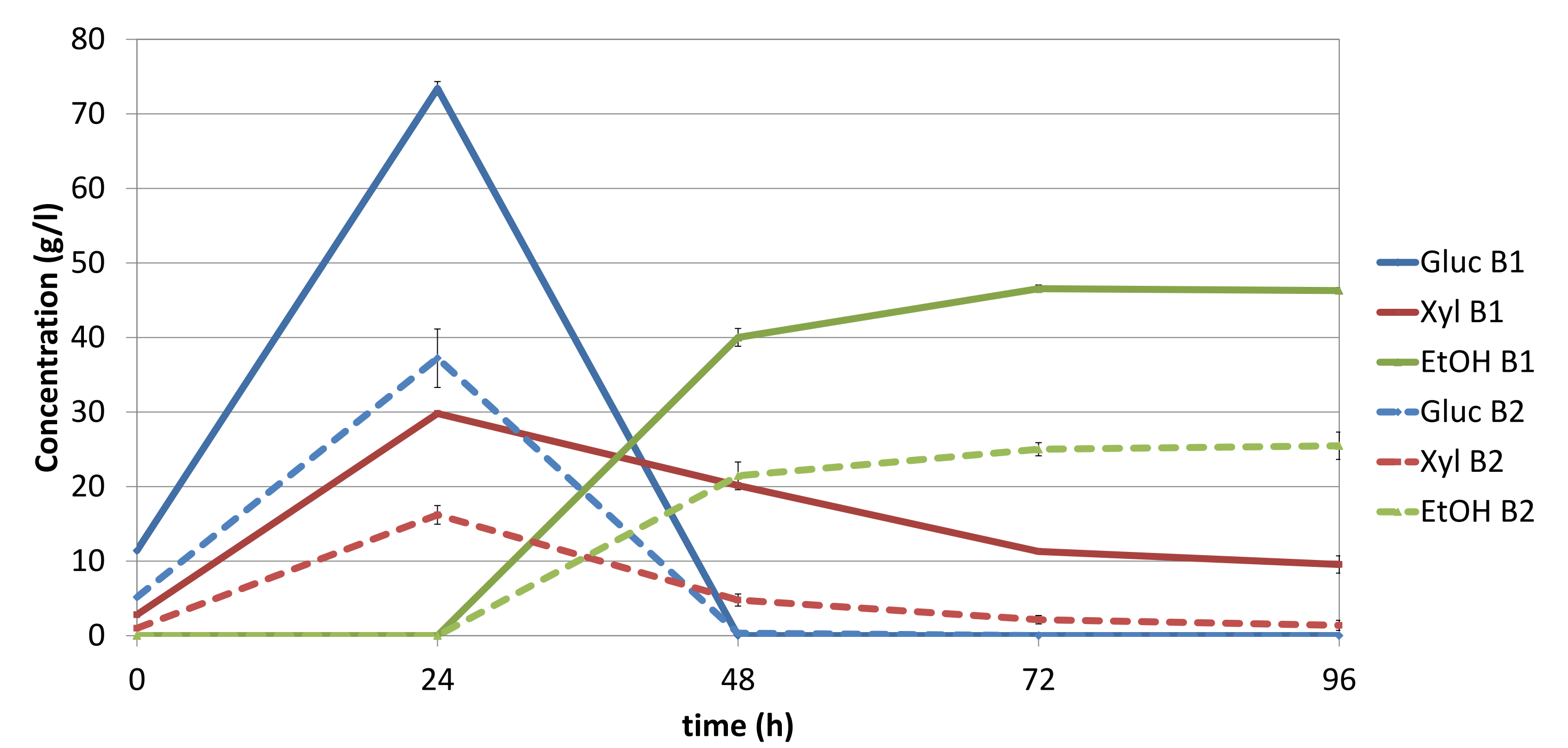
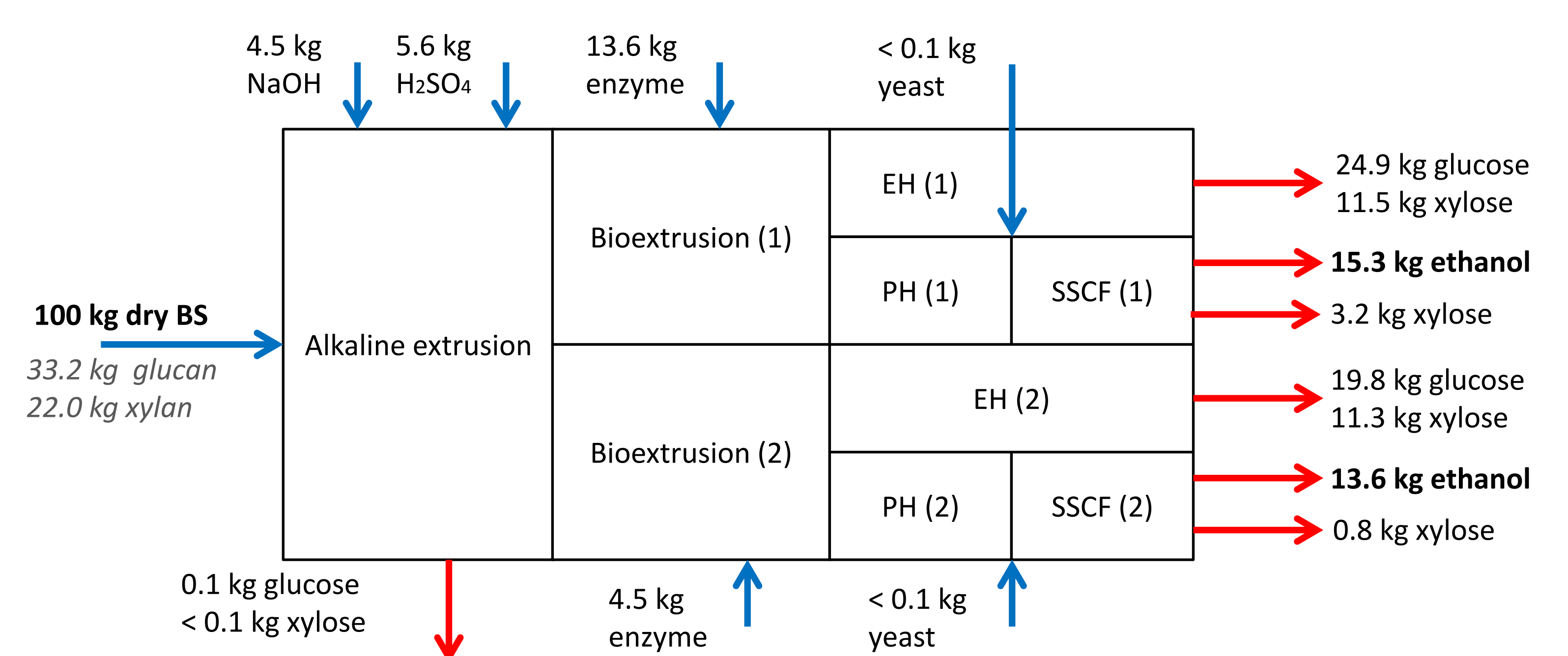


Figure 4– Mass balance



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