

**Fermentation of a complex organic
feedstock to medium chain carboxylates by
a natural microbial consortium :**

**Investigation on the substrate influence and
the process limitations**

APPENDIX

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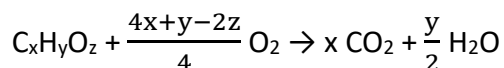
Academic year 2020-2021

Faculté des bioingénieurs, UCLouvain

Master's thesis presented in view of obtaining the Bioengineer diploma:
Agronomic sciences

A. Calculation of theoretical COD

To determine stoichiometrically the COD, the general formula of every organic substance that does not contain phosphorus, nitrogen or any heteroatom is:



Hence, one mol of $C_xH_yO_z$ reacts with $\frac{4x+y-2z}{4}$ mol O_2 . Considering that the molar mass of $C_xH_yO_z$ is $(12x+y+16z)$ g/mol and of O_2 is 32 g/mol, COD_{th} of the molecule is calculated by the following equation:

$$\text{Theoretical COD} = \text{COD}_{th} = 8 * \frac{4x + y - 2z}{12x + y + 16z} \text{ g}_{COD}/\text{g}_{vs}$$

The COD_{th} of the carboxylates and the ethanol which were monitored during the experiment are shown in Table I.

Table I: COD value in g_{COD}/g for carboxylates (from C2 to C8) and ethanol.

Substance	C2	C3	C4	C5	C6	C7	C8	EtOH
COD _{th} (g _{COD} /g)	1.07	1.51	1.82	2.04	2.21	2.34	2.44	2.09

B. Individual fermentation profiles

In the following pages, the fermentation profiles of the individual reactors are presented, respecting the order of the experiments. The fermentations which were already shown in the 'Results' part of the master's thesis (section 6) are not shown again.

R1, Exp 1:

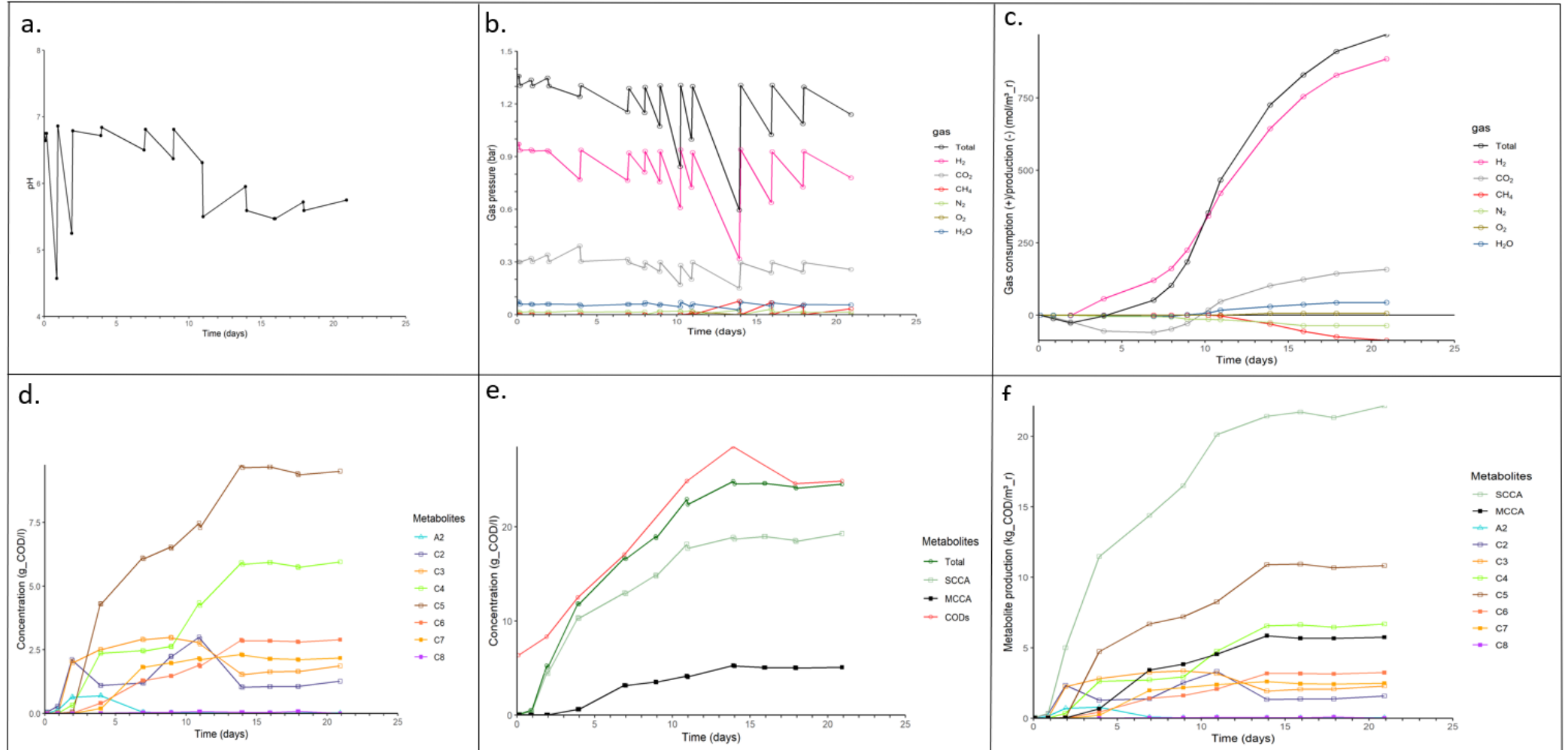


Figure I: Evolution over time of a) the pH ; b) the gas partial pressures ; c) the gas productions and consumptions ; d) the individual metabolite concentrations ; e) the grouped metabolite concentrations and total CODs ; f) the metabolite productions and consumptions, for the cBSG R1 of Exp 1.

R2, Exp 1:

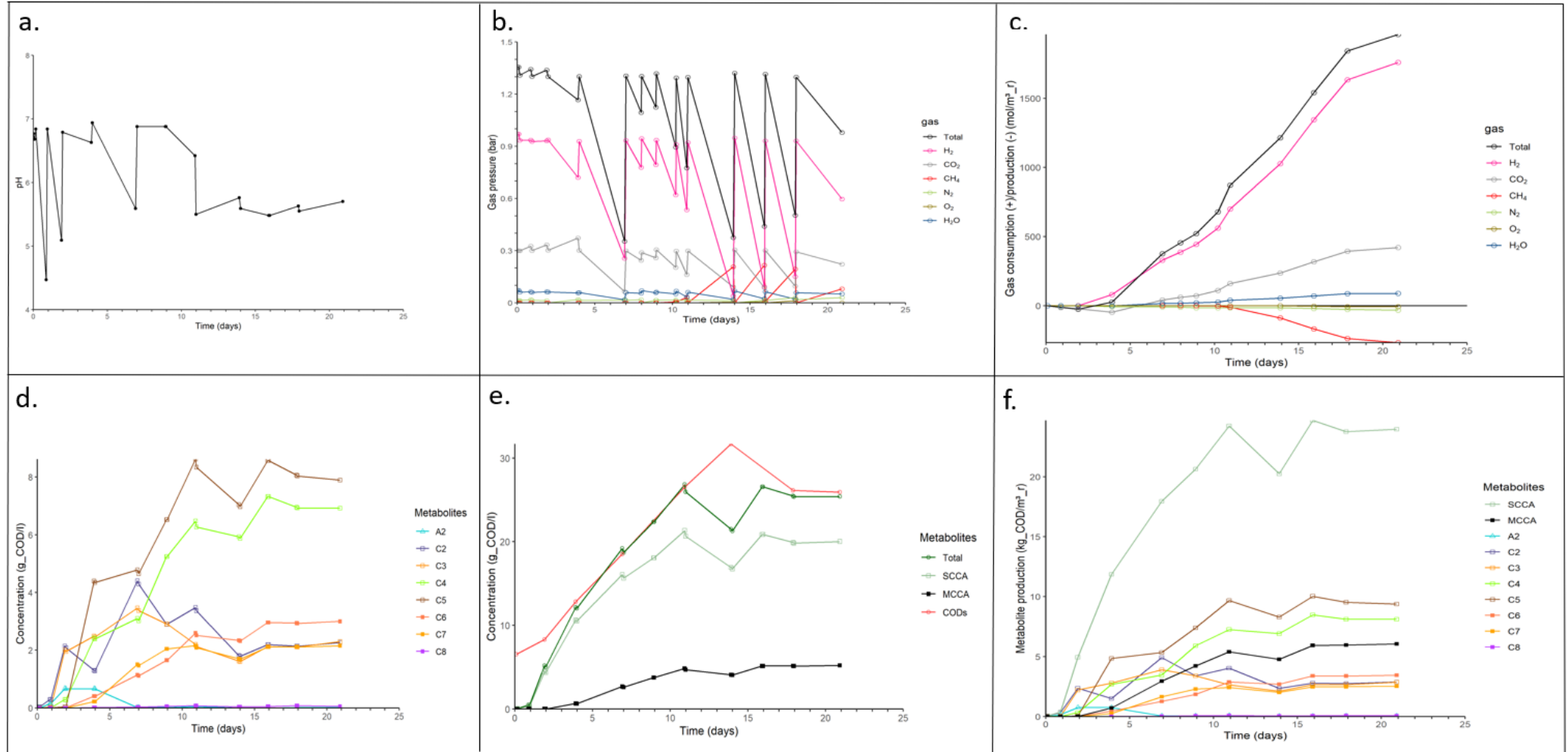


Figure II: Evolution over time of a) the pH ; b) the gas partial pressures ; c) the gas productions and consumptions ; d) the individual metabolite concentrations ; e) the grouped metabolite concentrations and total CODs ; f) the metabolite productions and consumptions, for the cBSG R2 of Exp 1.

R3, Exp 1:

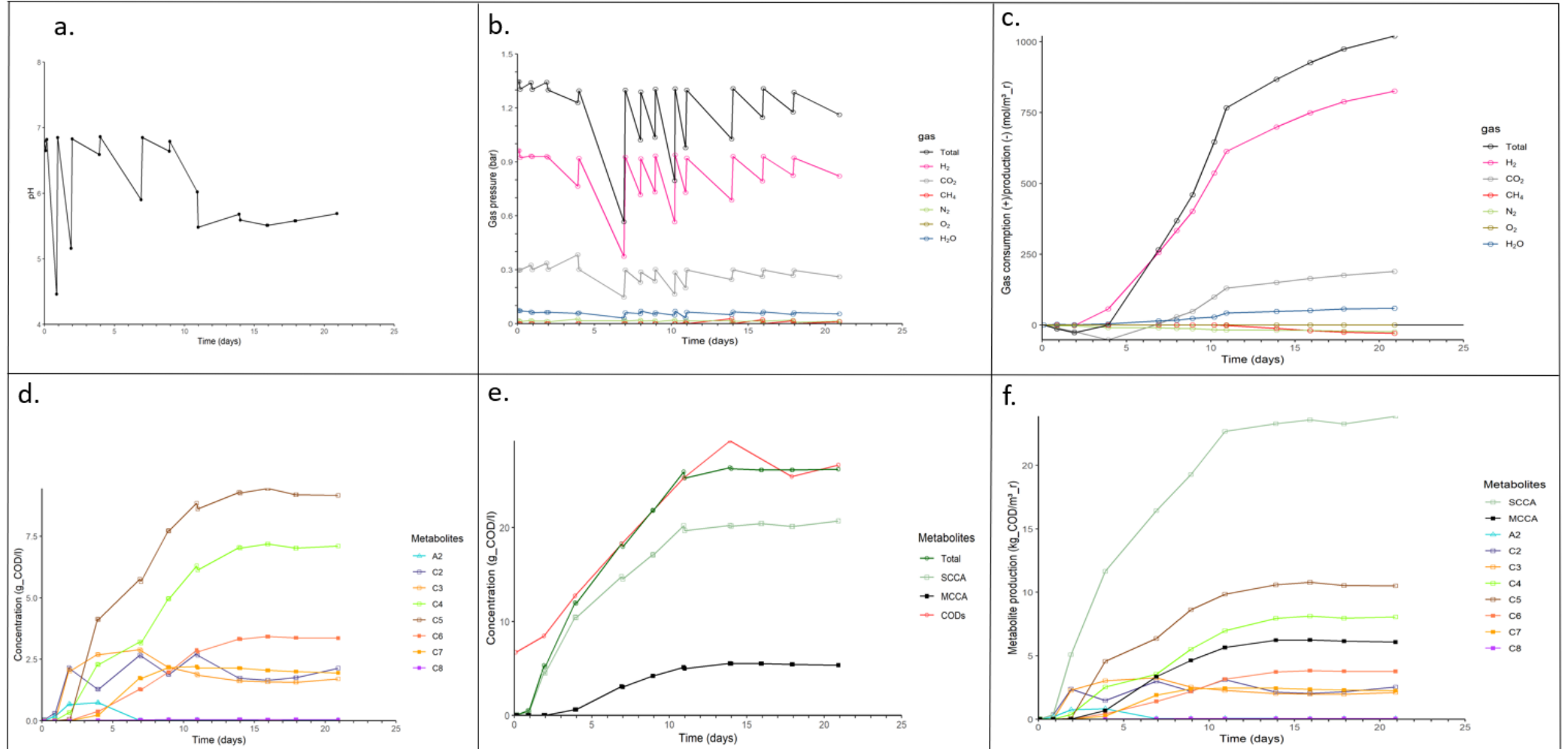


Figure III: Evolution over time of a) the pH ; b) the gas partial pressures ; c) the gas productions and consumptions ; d) the individual metabolite concentrations ; e) the grouped metabolite concentrations and total CODs ; f) the metabolite productions and consumptions, for the cBSG R3 of Exp 1.

R4, Exp 1:

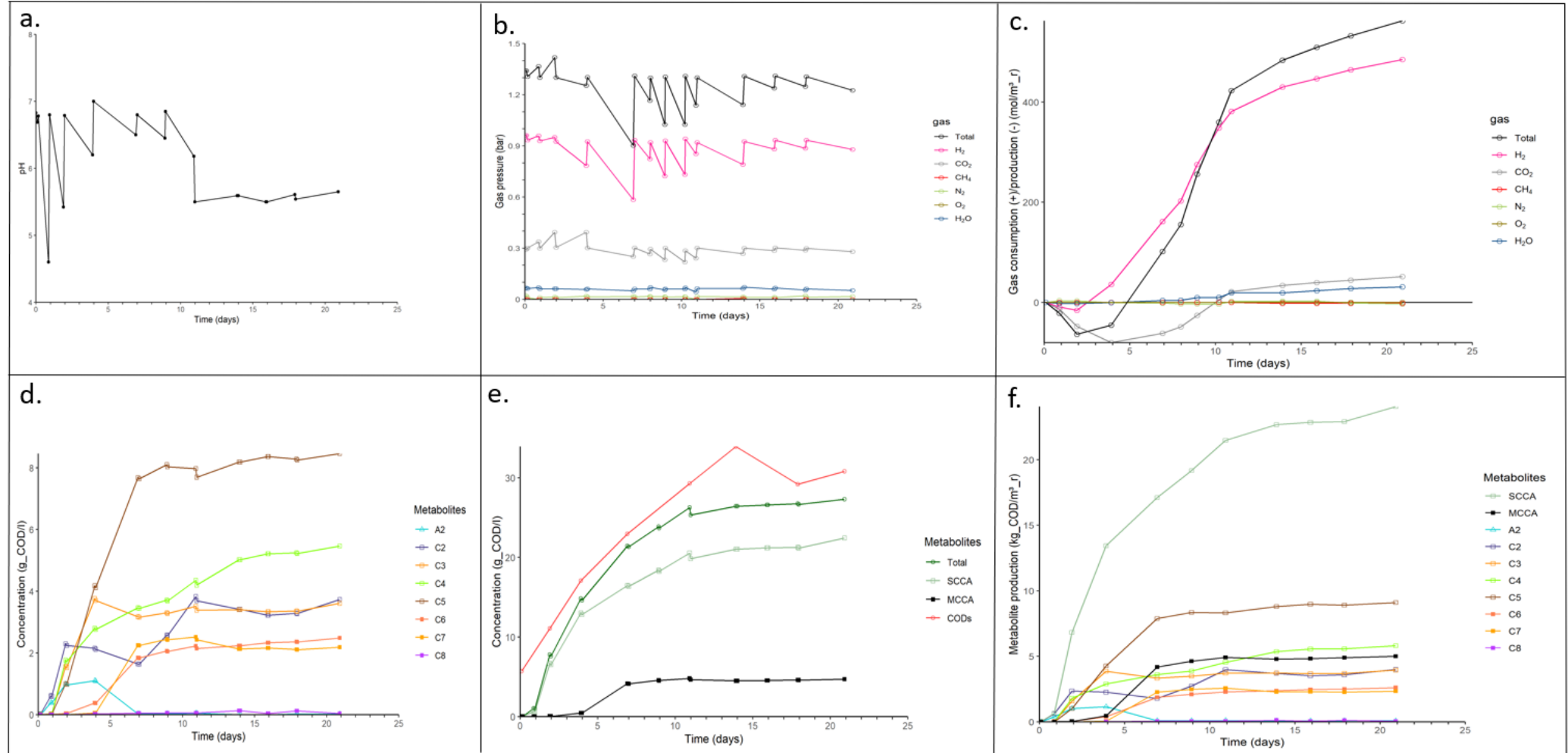


Figure IV: Evolution over time of a) the pH ; b) the gas partial pressures ; c) the gas productions and consumptions ; d) the individual metabolite concentrations ; e) the grouped metabolite concentrations and total CODs ; f) the metabolite productions and consumptions, for the pBSG R4 of Exp 1.

R5, Exp 1:

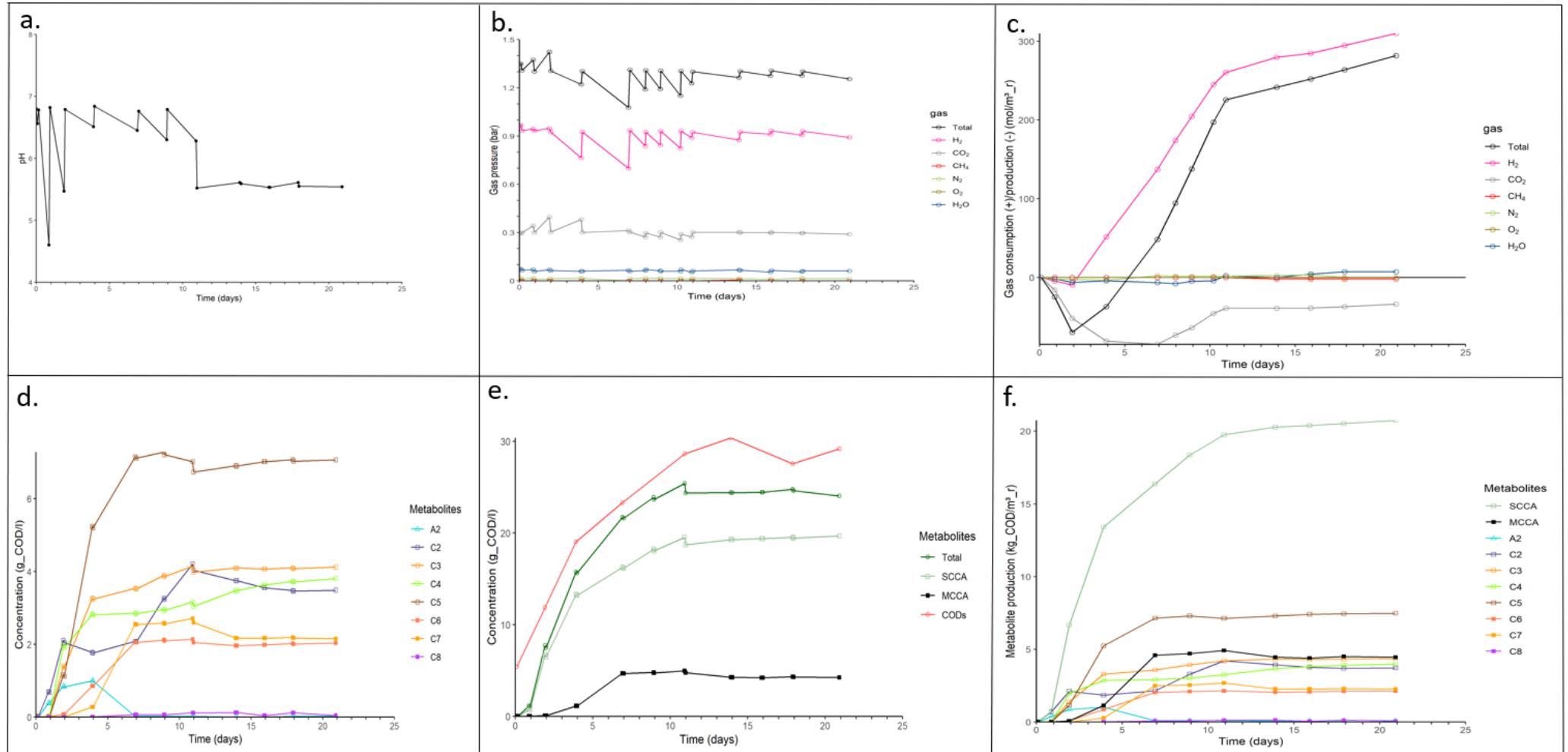


Figure V: Evolution over time of a) the pH ; b) the gas partial pressures ; c) the gas productions and consumptions ; d) the individual metabolite concentrations ; e) the grouped metabolite concentrations and total CODs ; f) the metabolite productions and consumptions, for the pBSG R5 of Exp 1.

R6, Exp 1:

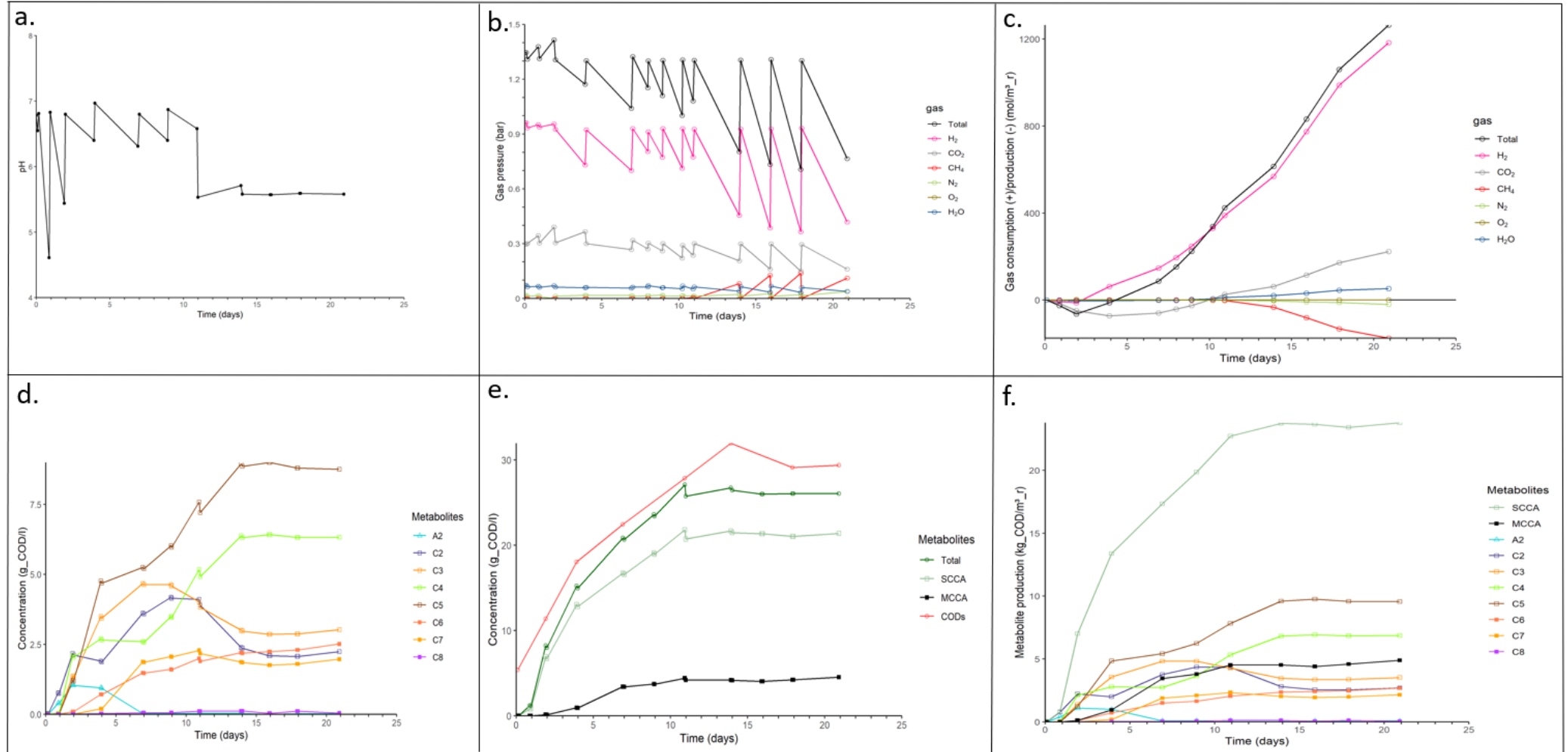


Figure VI: Evolution over time of a) the pH ; b) the gas partial pressures ; c) the gas productions and consumptions ; d) the individual metabolite concentrations ; e) the grouped metabolite concentrations and total CODs ; f) the metabolite productions and consumptions, for the pBSG R6 of Exp 1.

R19, Exp 1:

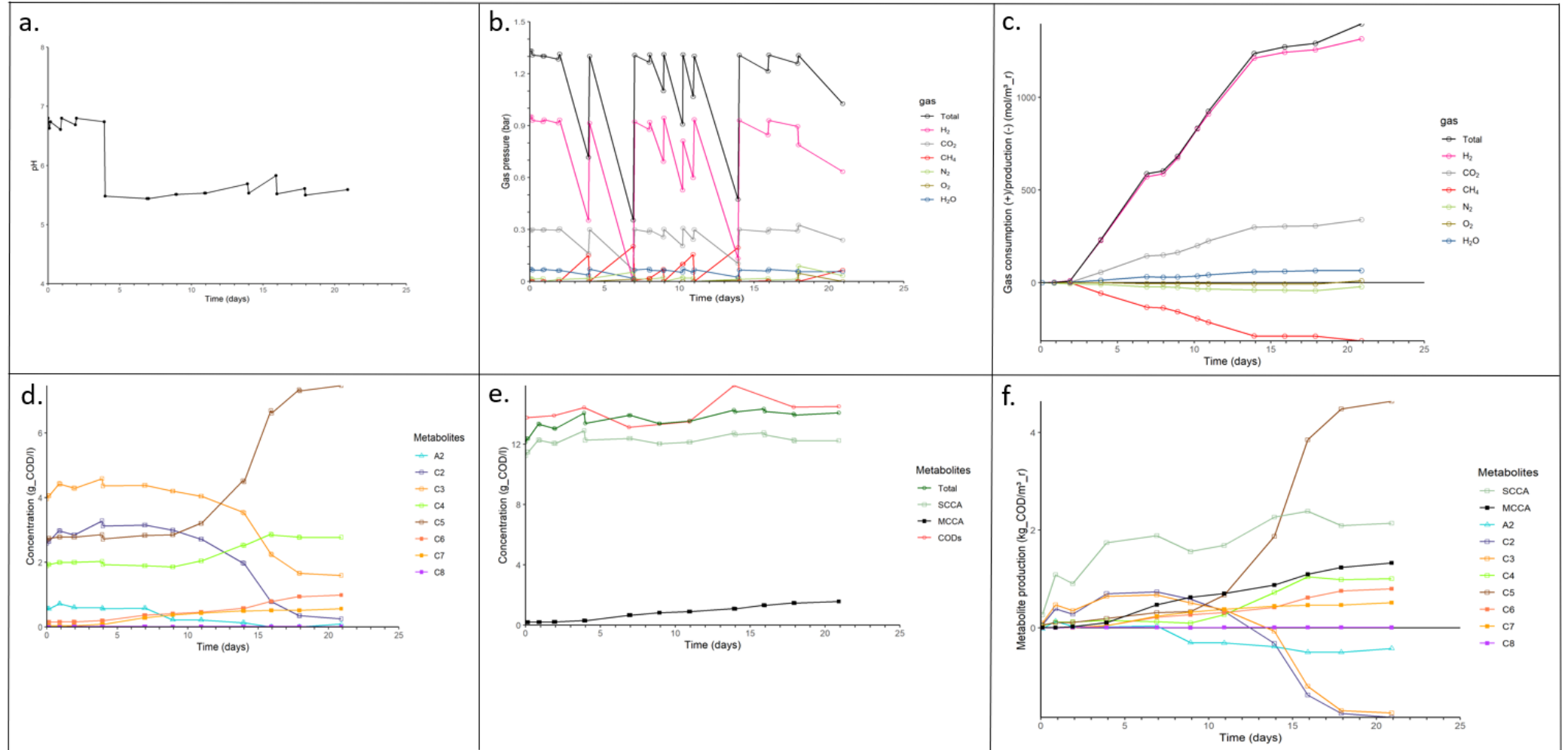


Figure VII: Evolution over time of a) the pH ; b) the gas partial pressures ; c) the gas productions and consumptions ; d) the individual metabolite concentrations ; e) the grouped metabolite concentrations and total CODs ; f) the metabolite productions and consumptions, for the AML R19 of Exp 1.

R20, Exp 1:

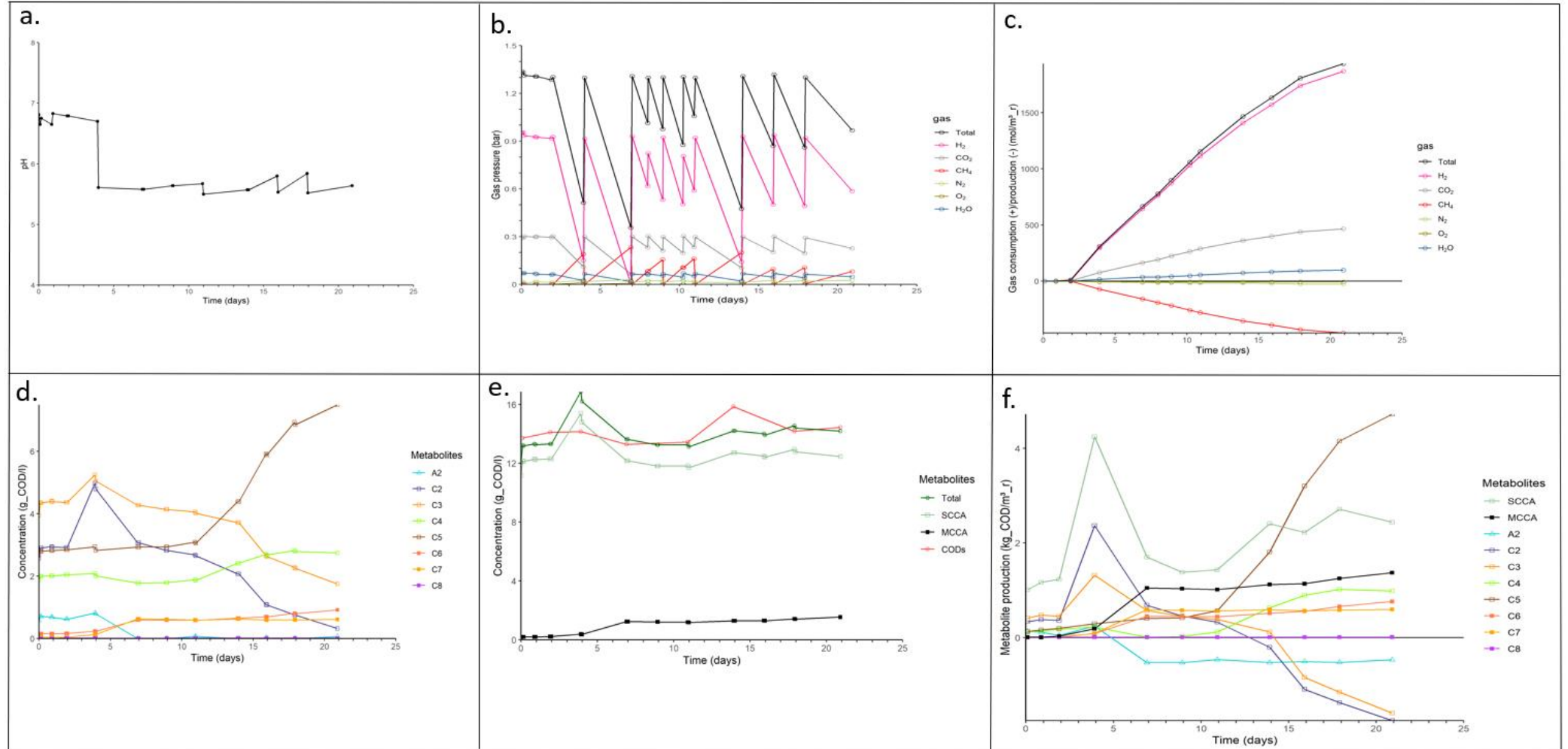


Figure VIII: Evolution over time of a) the pH ; b) the gas partial pressures ; c) the gas productions and consumptions ; d) the individual metabolite concentrations ; e) the grouped metabolite concentrations and total CODs ; f) the metabolite productions and consumptions, for the AML R20 of Exp 1.

R21, Exp 1:

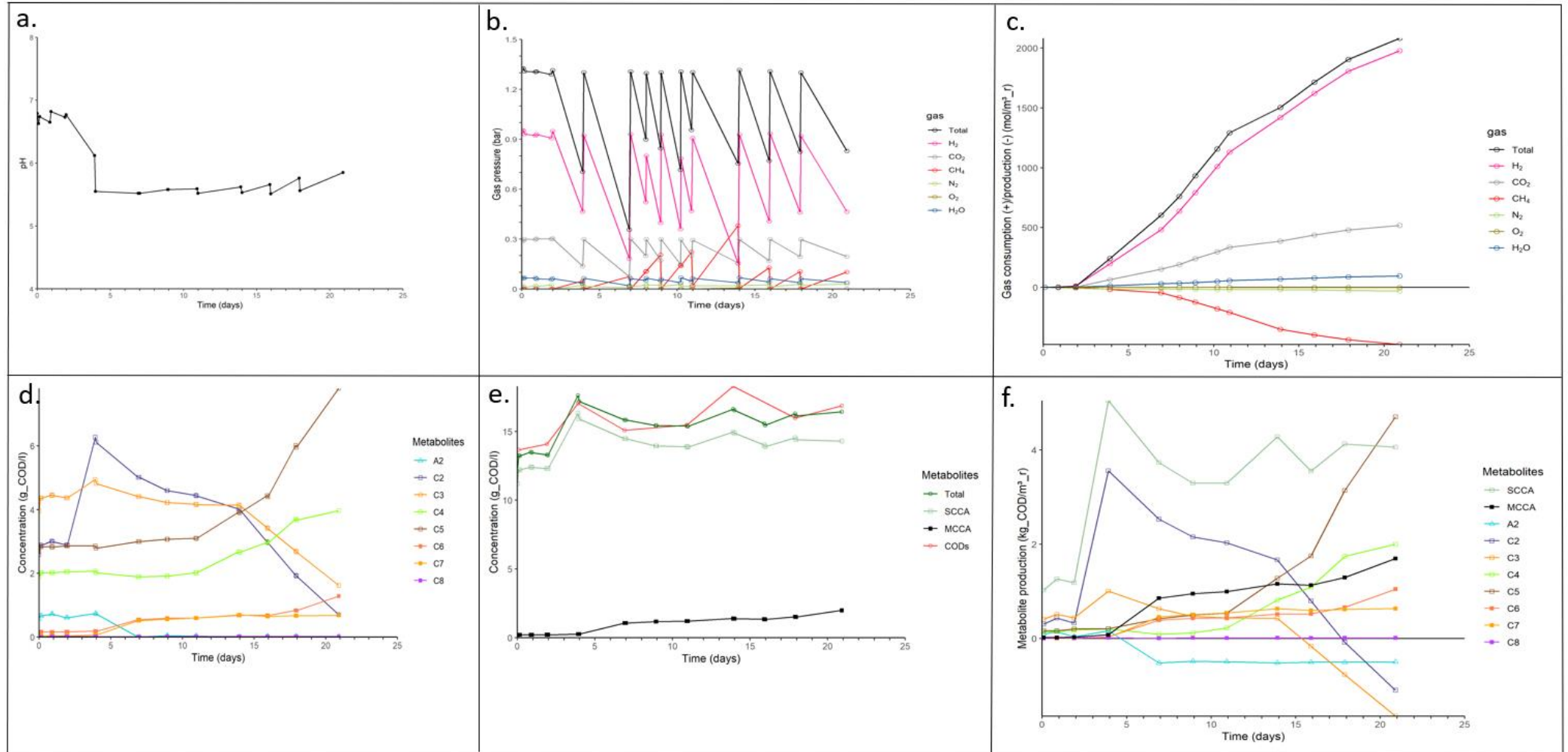


Figure IX: Evolution over time of a) the pH ; b) the gas partial pressures ; c) the gas productions and consumptions ; d) the individual metabolite concentrations ; e) the grouped metabolite concentrations and total CODs ; f) the metabolite productions and consumptions, for the AML R21 of Exp 1.

R13, Exp 1:

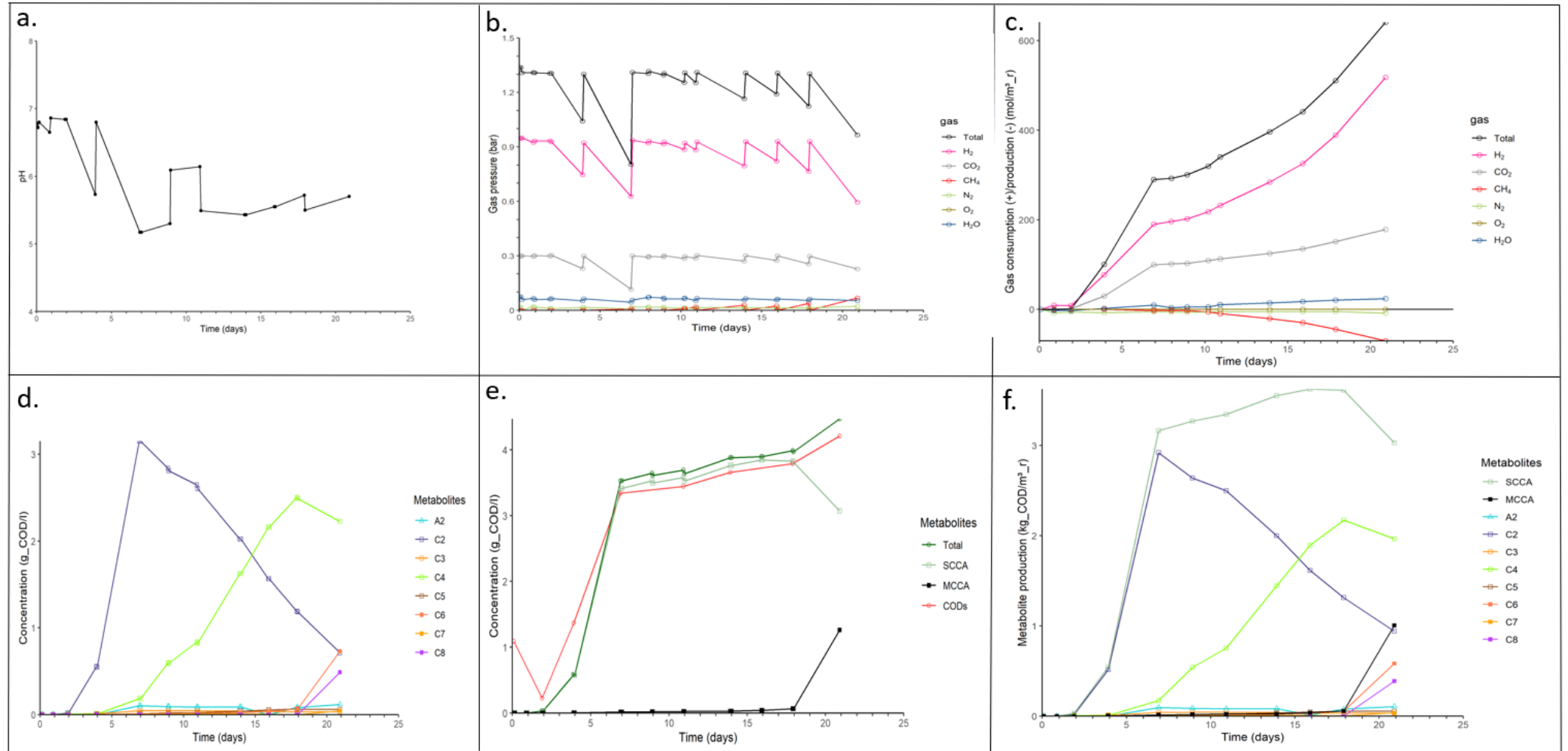


Figure X: Evolution over time of a) the pH ; b) the gas partial pressures ; c) the gas productions and consumptions ; d) the individual metabolite concentrations ; e) the grouped metabolite concentrations and total CODs ; f) the metabolite productions and consumptions, for the NOF R13 of Exp 1.

R14, Exp 1:

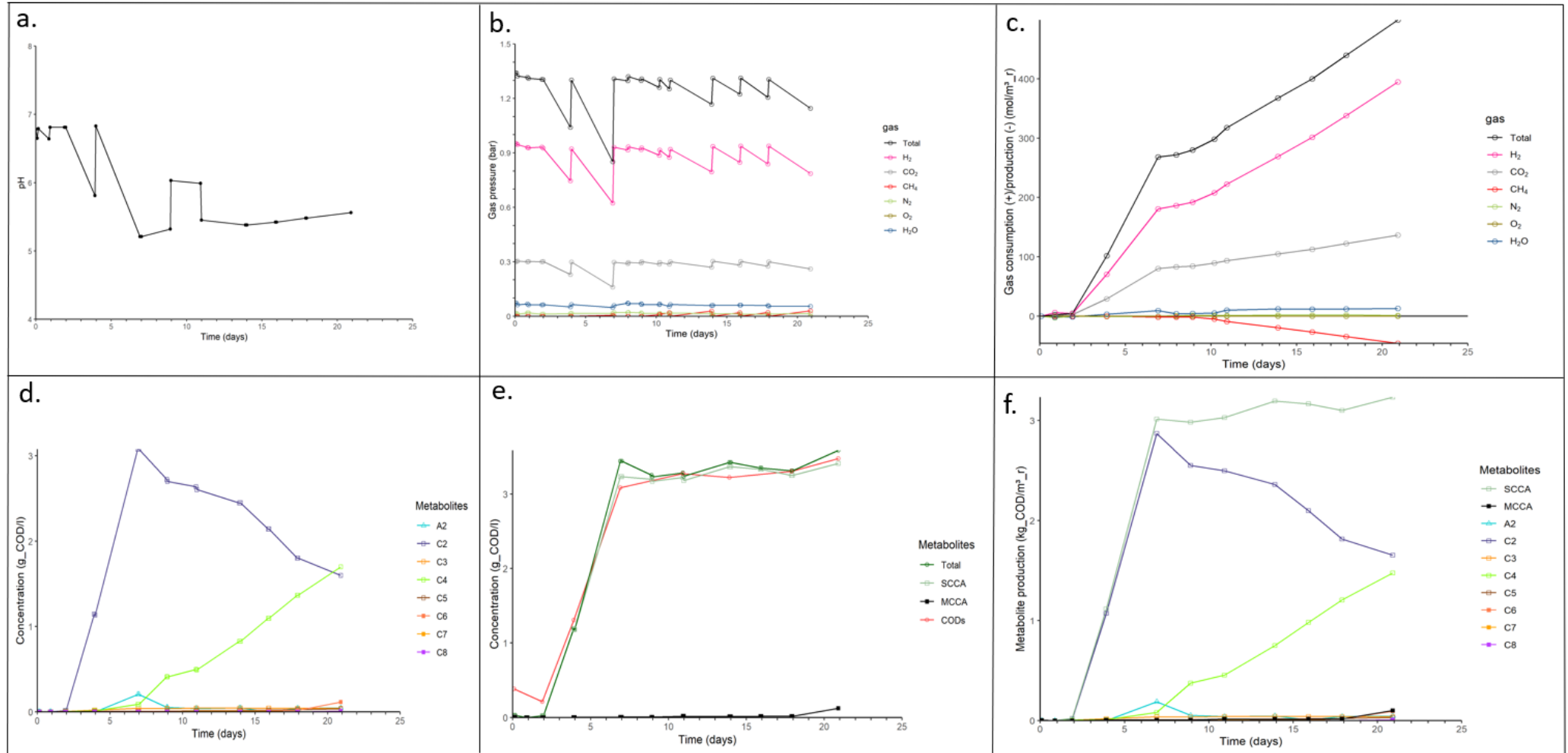


Figure XI: Evolution over time of a) the pH ; b) the gas partial pressures ; c) the gas productions and consumptions ; d) the individual metabolite concentrations ; e) the grouped metabolite concentrations and total CODs ; f) the metabolite productions and consumptions, for the NOF R14 of Exp 1.

R15, Exp 1:

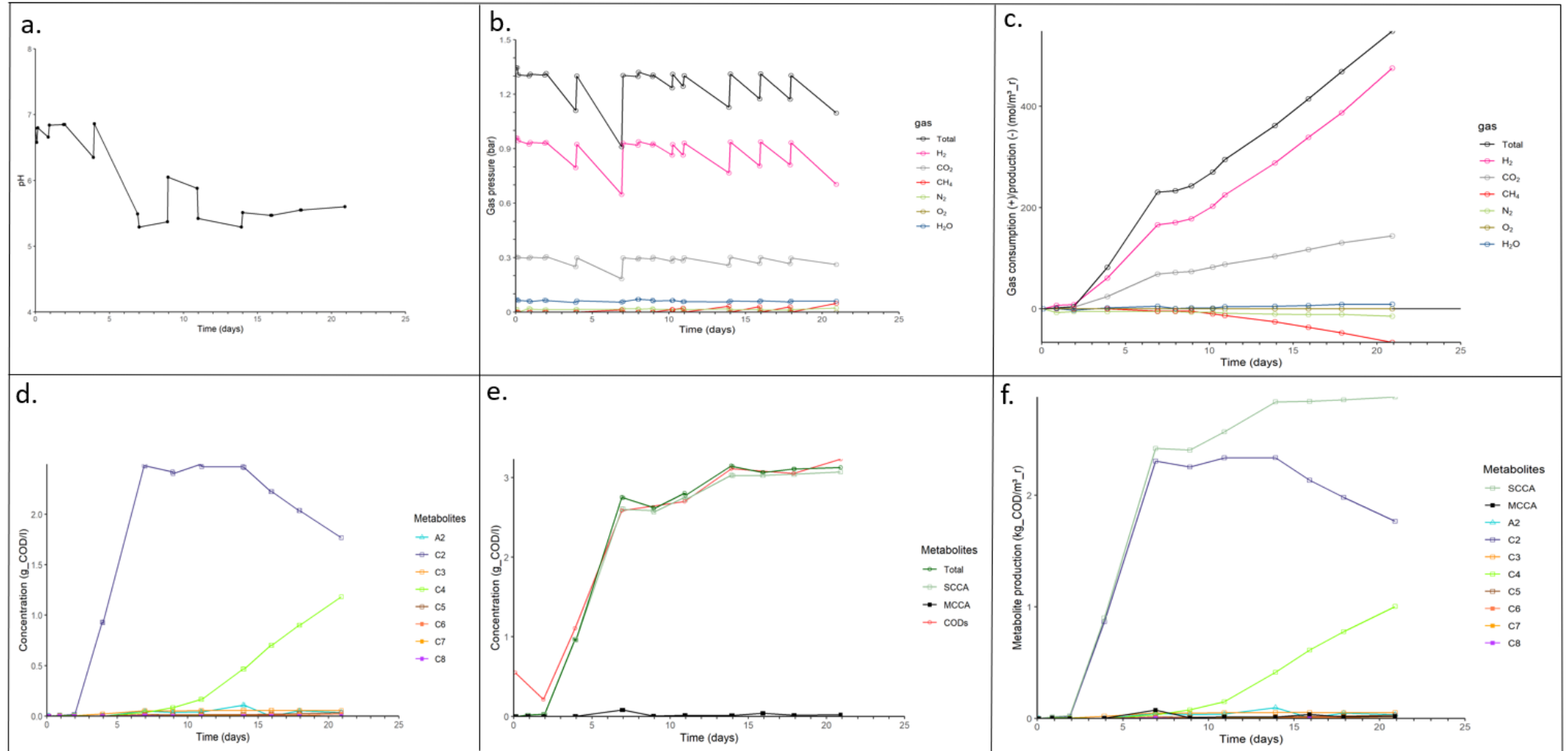


Figure XII: Evolution over time of a) the pH ; b) the gas partial pressures ; c) the gas productions and consumptions ; d) the individual metabolite concentrations ; e) the grouped metabolite concentrations and total CODs ; f) the metabolite productions and consumptions, for the NOF R15 of Exp 1.

R1, Exp 2:

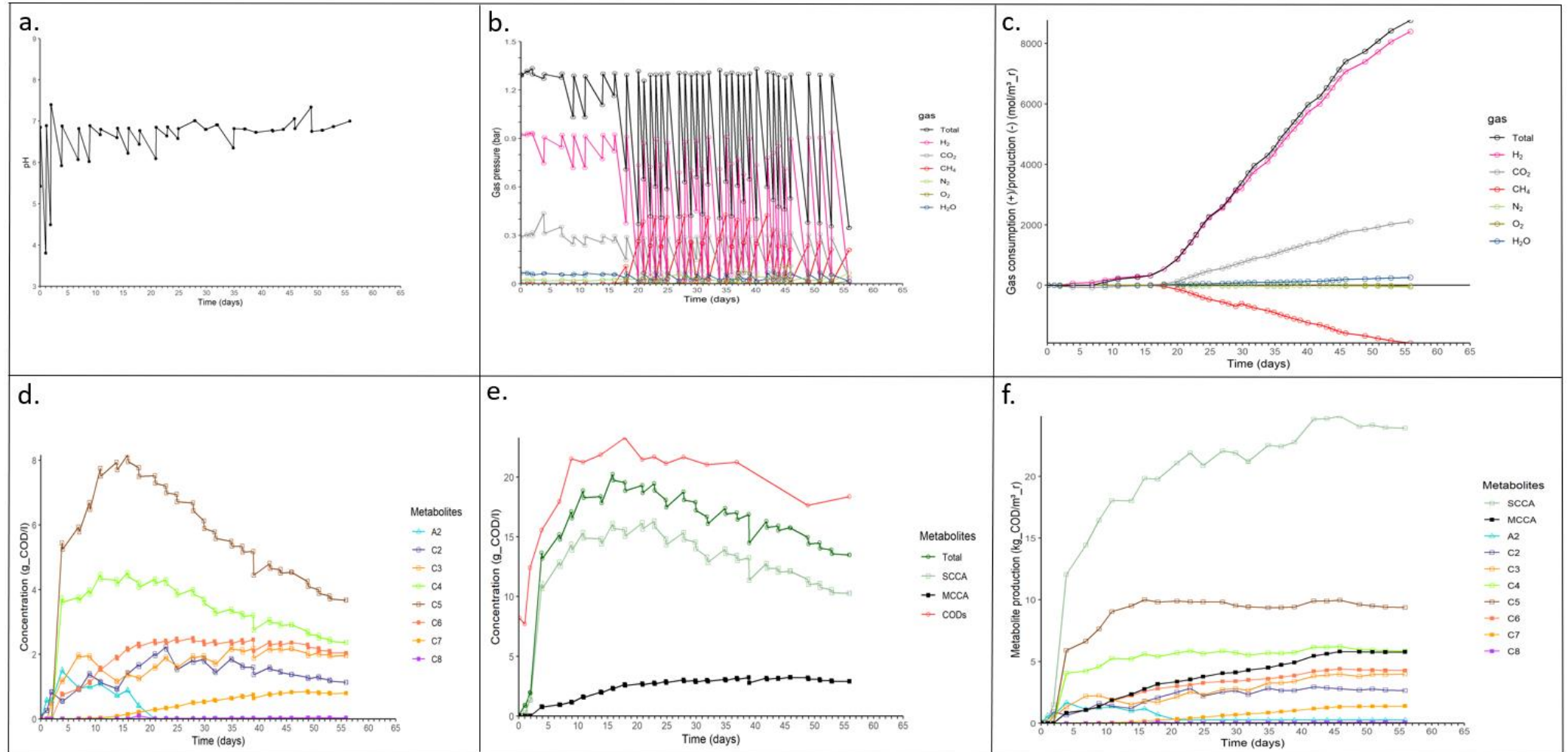


Figure XIII: Evolution over time of a) the pH ; b) the gas partial pressures ; c) the gas productions and consumptions ; d) the individual metabolite concentrations ; e) the grouped metabolite concentrations and total CODs ; f) the metabolite productions and consumptions, for the R1 of Exp 2.

R2, Exp 2:

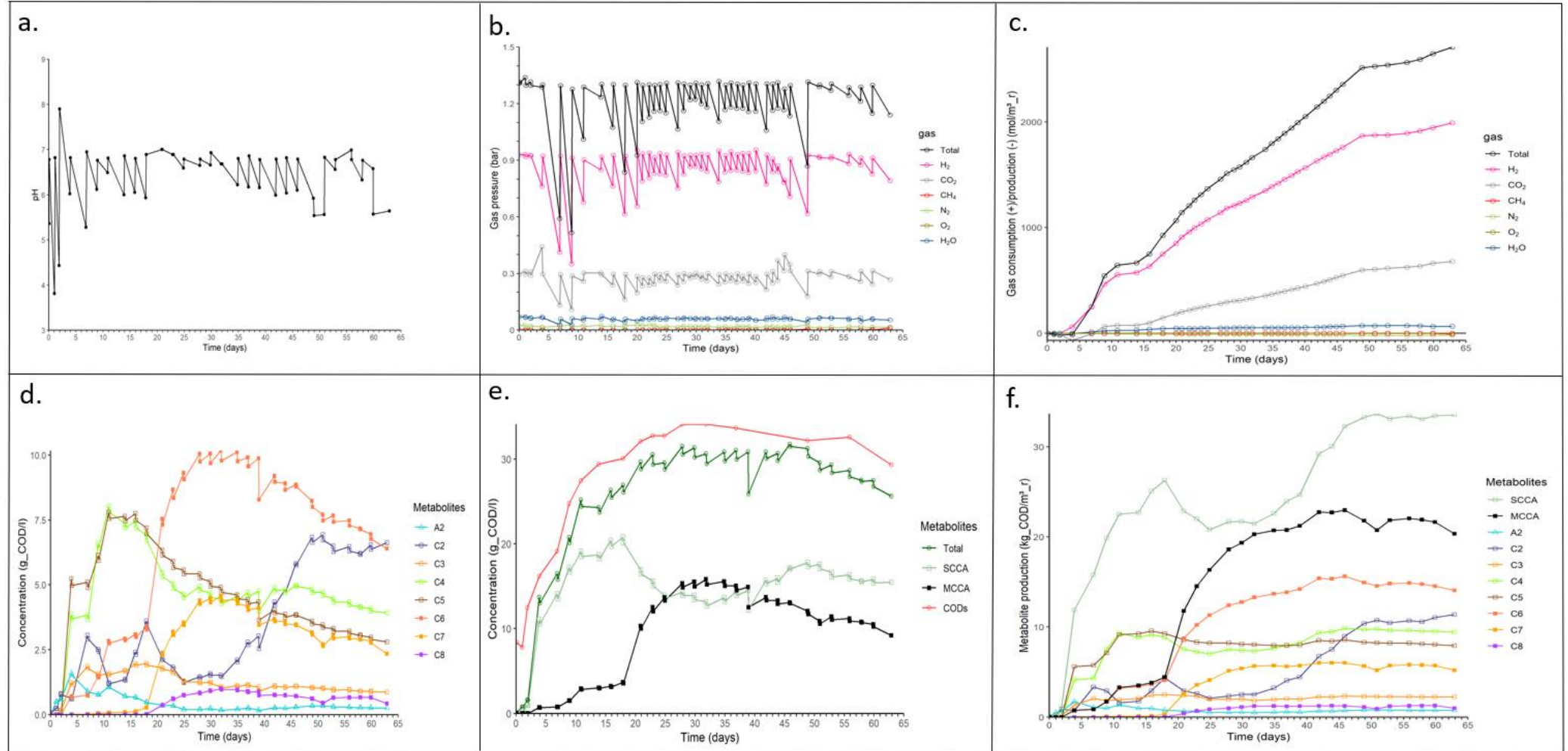


Figure XIV: Evolution over time of a) the pH ; b) the gas partial pressures ; c) the gas productions and consumptions ; d) the individual metabolite concentrations ; e) the grouped metabolite concentrations and total CODs ; f) the metabolite productions and consumptions, for the R2 of Exp 2.

R3, Exp 2:

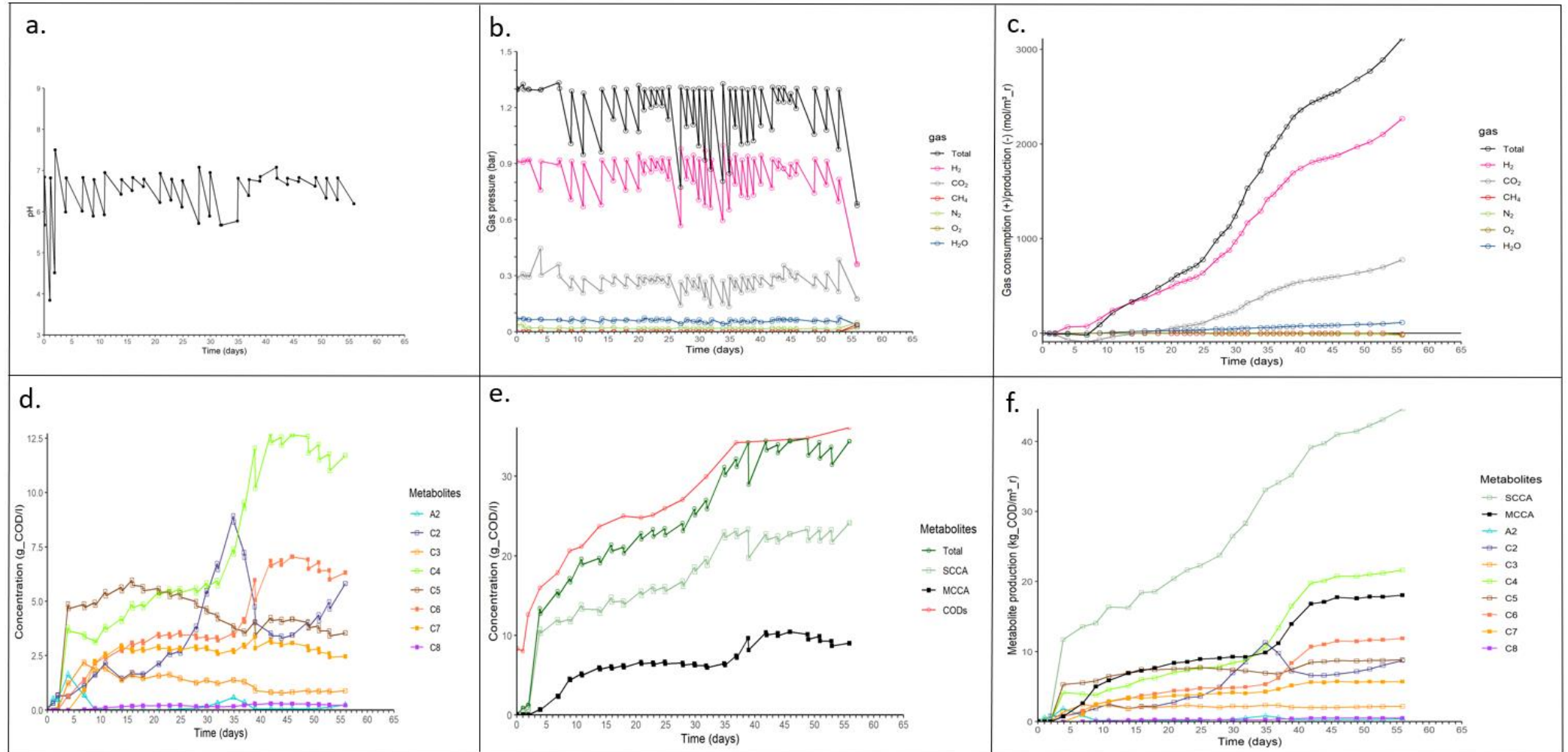


Figure XV: Evolution over time of a) the pH ; b) the gas partial pressures ; c) the gas productions and consumptions ; d) the individual metabolite concentrations ; e) the grouped metabolite concentrations and total CODs ; f) the metabolite productions and consumptions, for the R3 of Exp 2.

R4, Exp 2:

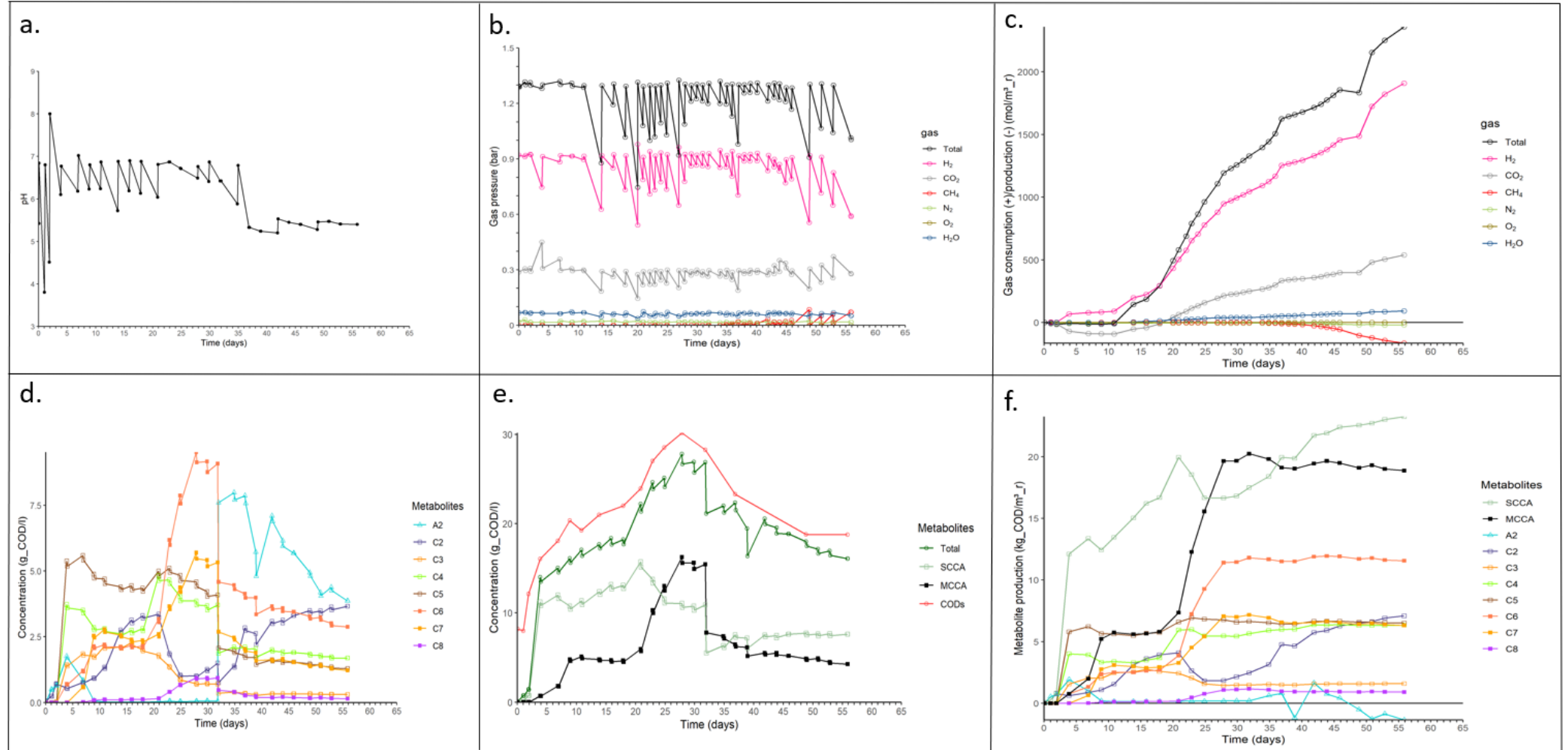


Figure XVI: Evolution over time of a) the pH ; b) the gas partial pressures ; c) the gas productions and consumptions ; d) the individual metabolite concentrations ; e) the grouped metabolite concentrations and total CODs ; f) the metabolite productions and consumptions, for the R4 of Exp 2.

R5, Exp 2:

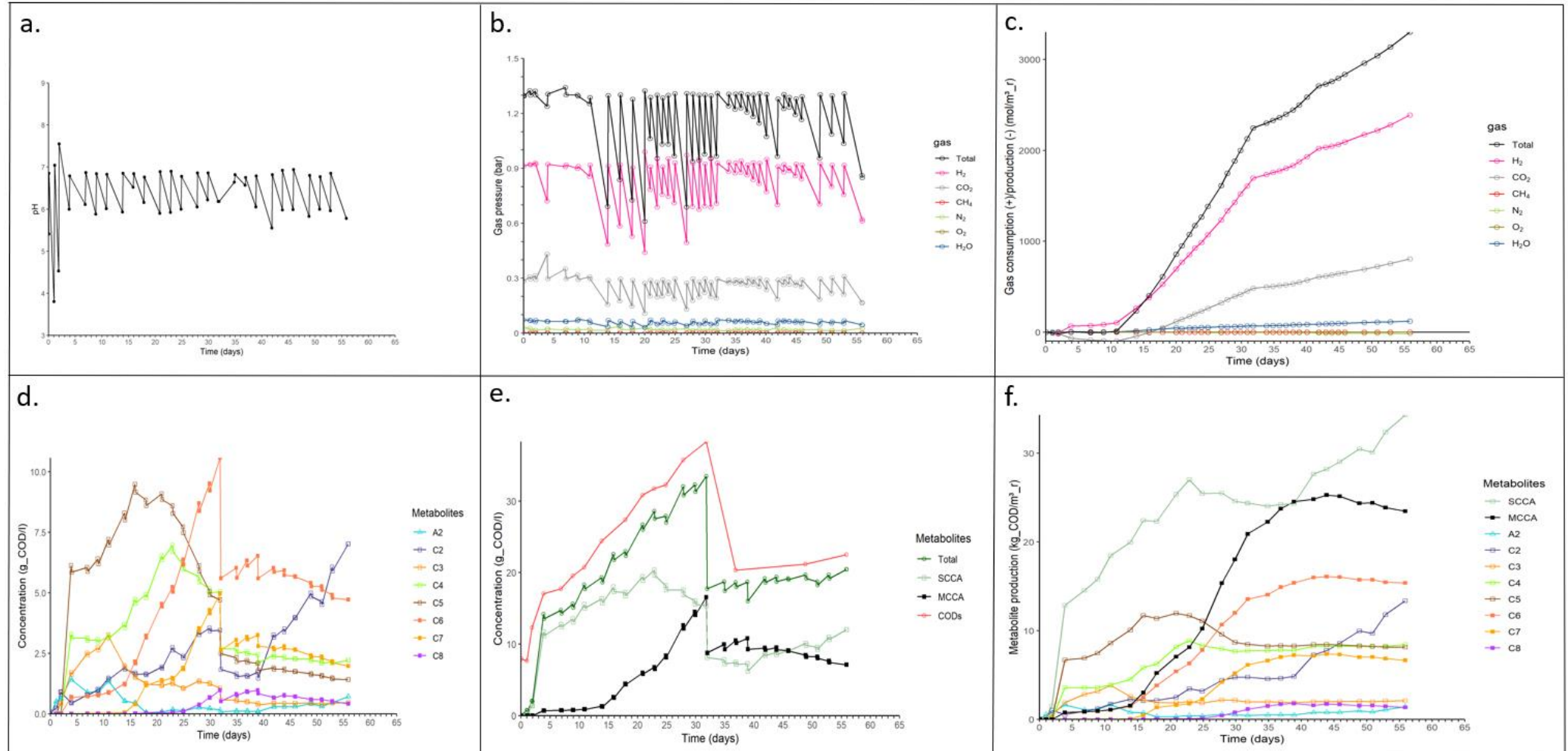


Figure XVII: Evolution over time of a) the pH ; b) the gas partial pressures ; c) the gas productions and consumptions ; d) the individual metabolite concentrations ; e) the grouped metabolite concentrations and total CODs ; f) the metabolite productions and consumptions, for the R5 of Exp 2.

R6, Exp 2:

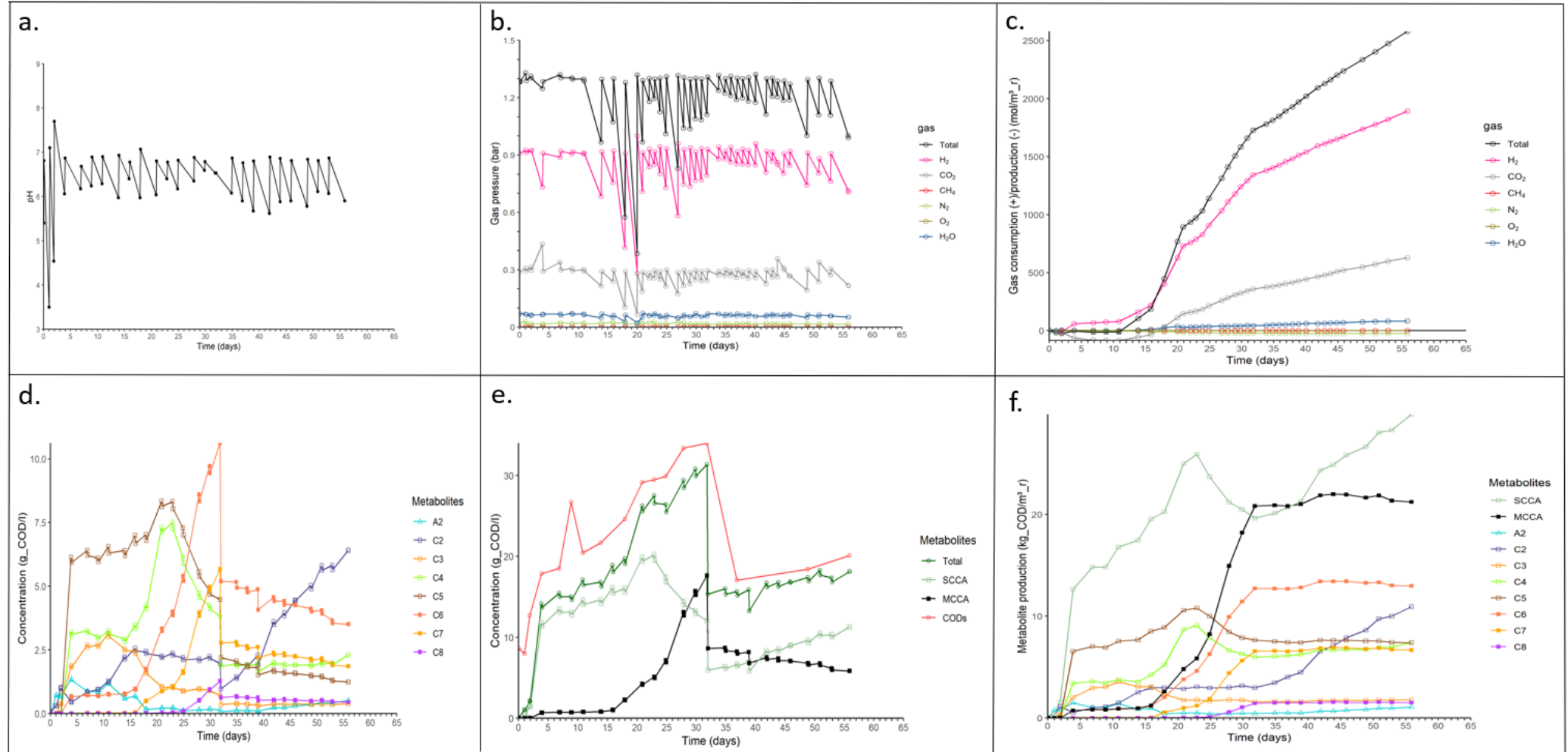


Figure XVIII: Evolution over time of a) the pH ; b) the gas partial pressures ; c) the gas productions and consumptions ; d) the individual metabolite concentrations ; e) the grouped metabolite concentrations and total CODs ; f) the metabolite productions and consumptions, for the R6 of Exp 2.

R7, Exp 2:

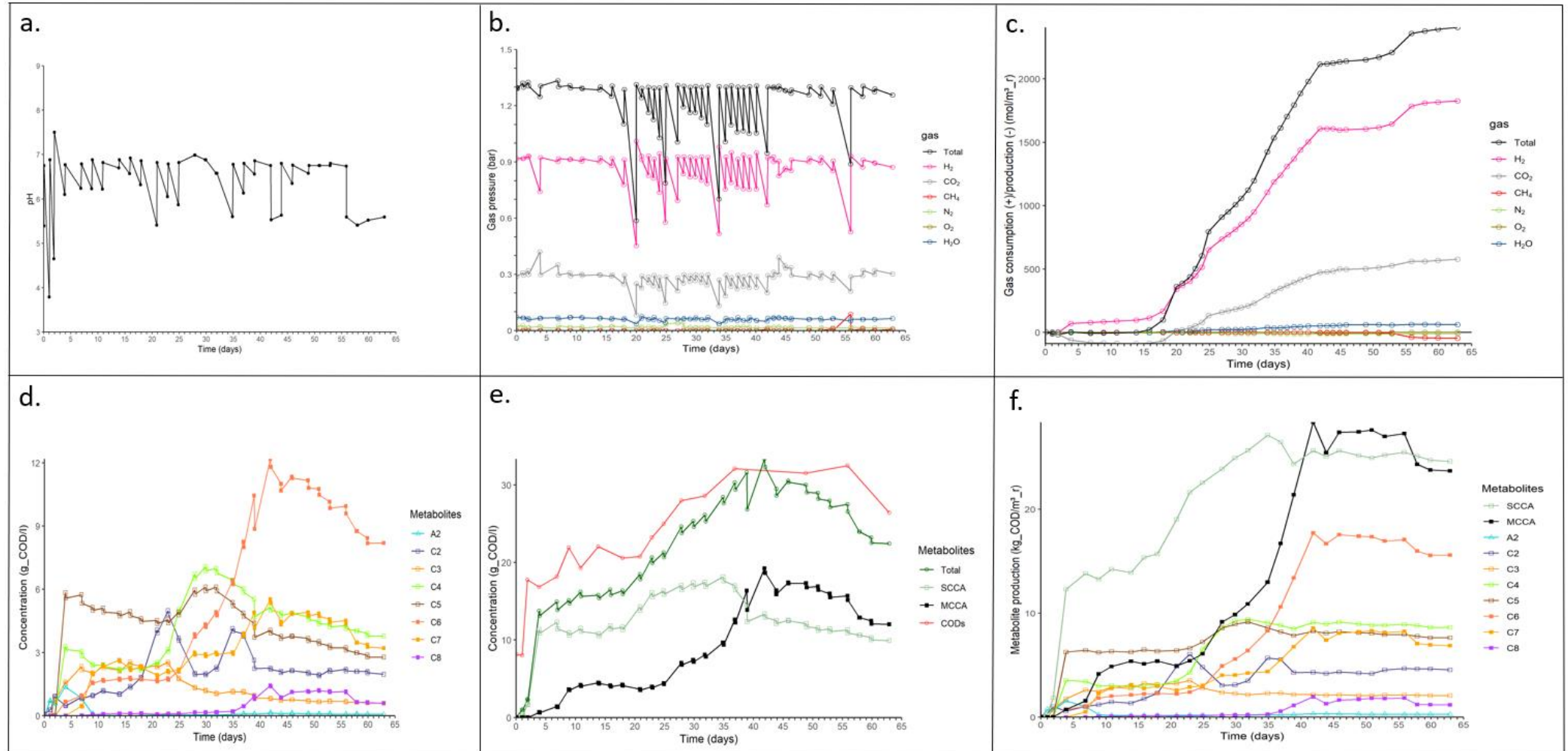


Figure XIX: Evolution over time of a) the pH ; b) the gas partial pressures ; c) the gas productions and consumptions ; d) the individual metabolite concentrations ; e) the grouped metabolite concentrations and total CODs ; f) the metabolite productions and consumptions, for the R7 of Exp 2.

R8, Exp 2:

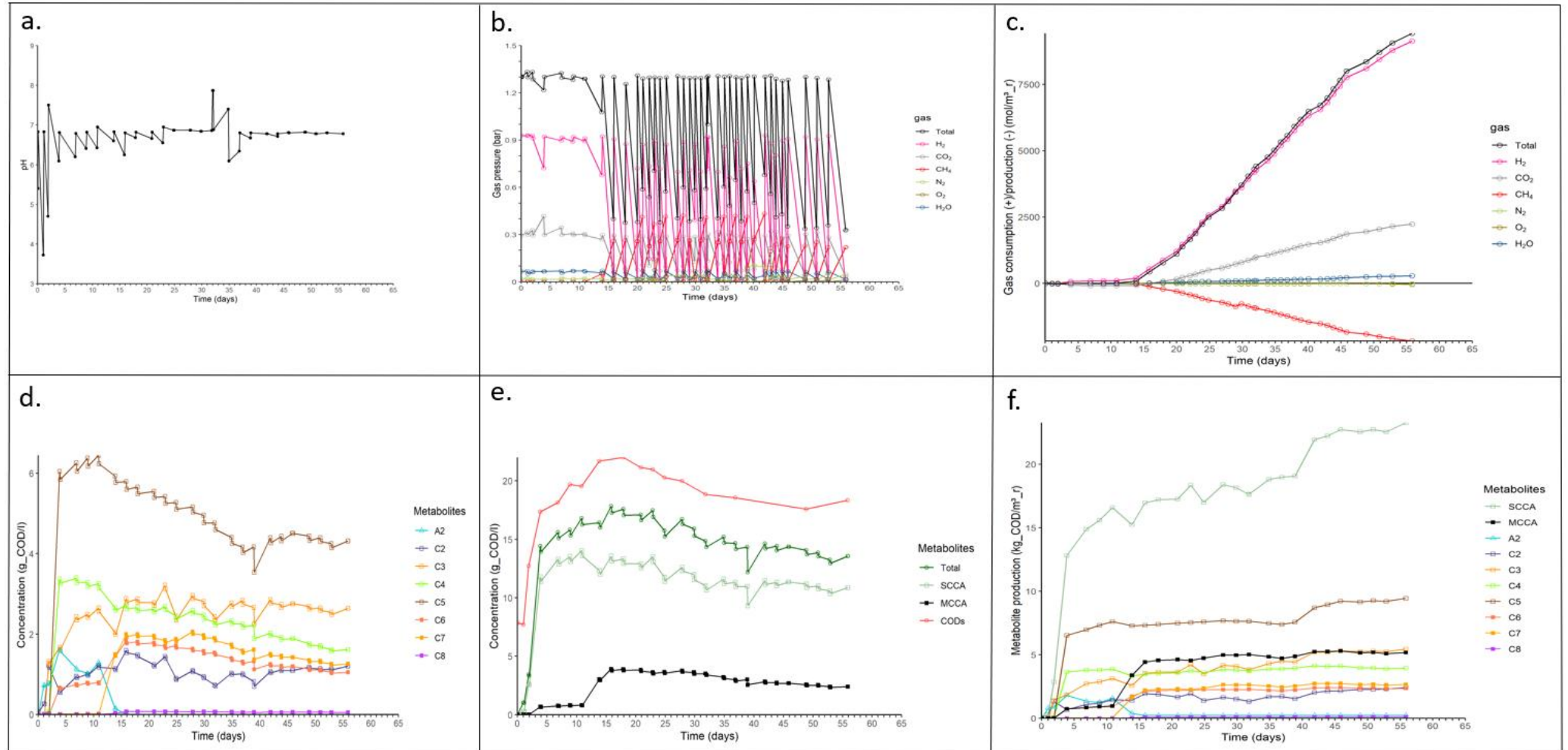


Figure XX: Evolution over time of a) the pH ; b) the gas partial pressures ; c) the gas productions and consumptions ; d) the individual metabolite concentrations ; e) the grouped metabolite concentrations and total CODs ; f) the metabolite productions and consumptions, for the R8 of Exp 2.

R9, Exp 2:

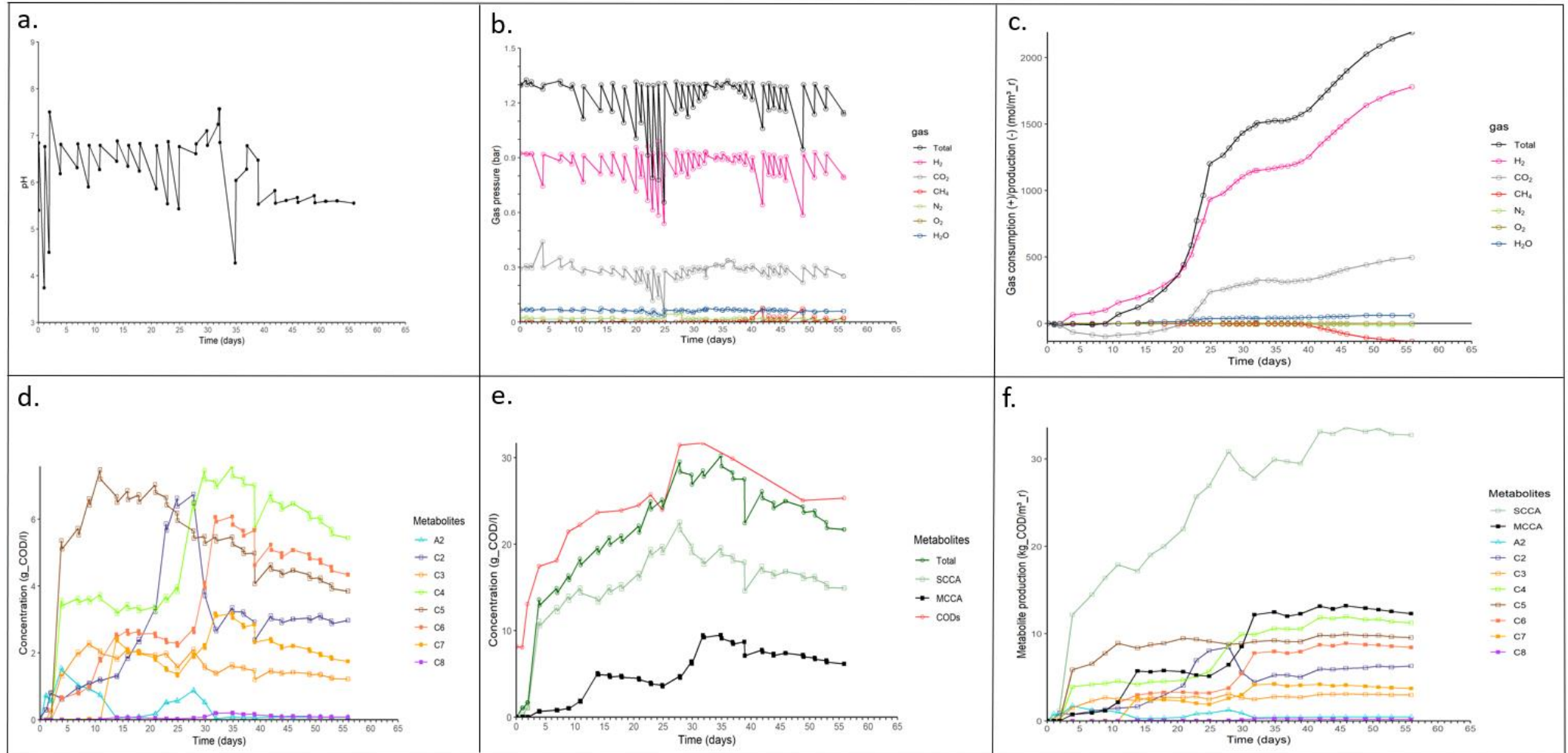


Figure XXI: Evolution over time of a) the pH ; b) the gas partial pressures ; c) the gas productions and consumptions ; d) the individual metabolite concentrations ; e) the grouped metabolite concentrations and total CODs ; f) the metabolite productions and consumptions, for the R9 of Exp 2.

R10, Exp 2:

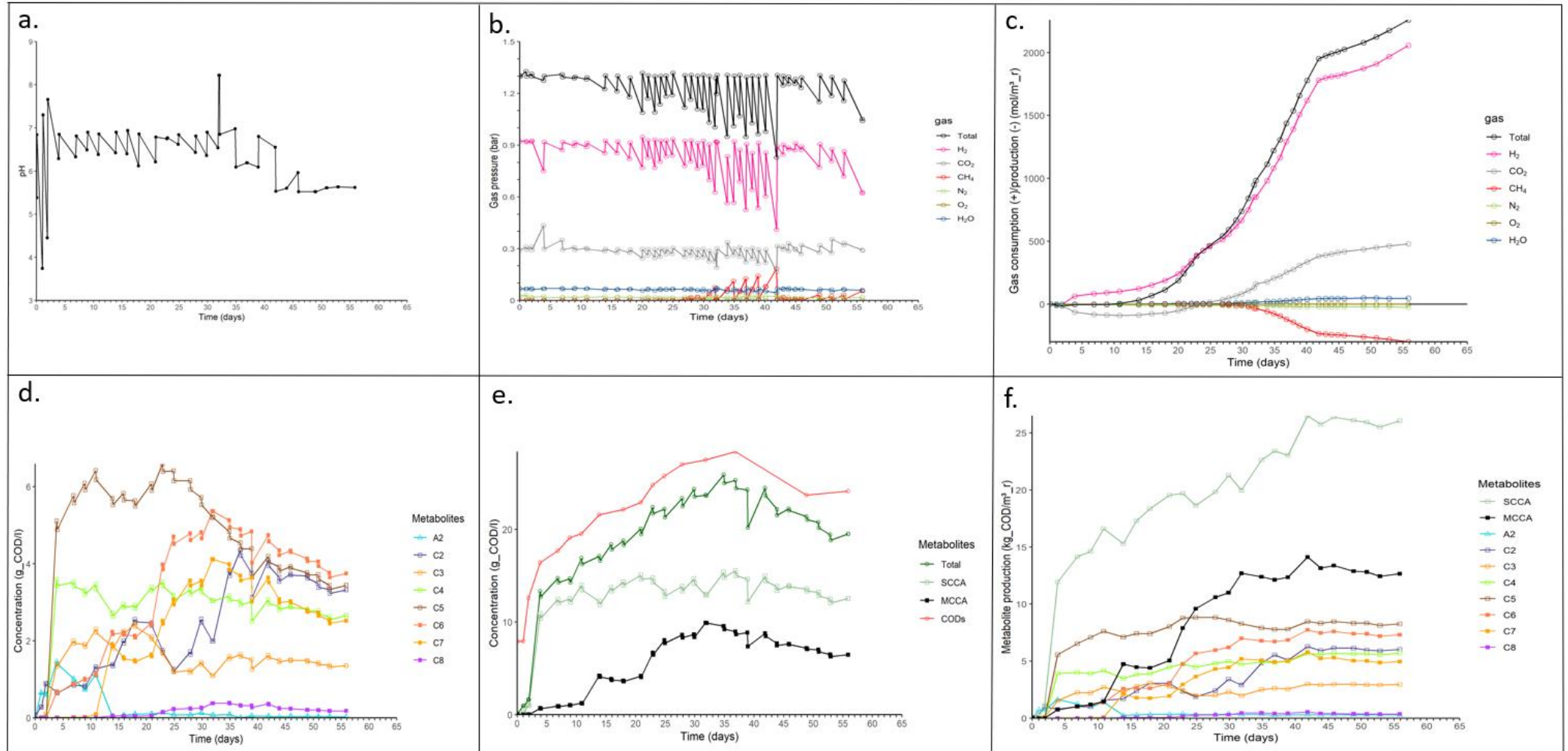


Figure XXII: Evolution over time of a) the pH ; b) the gas partial pressures ; c) the gas productions and consumptions ; d) the individual metabolite concentrations ; e) the grouped metabolite concentrations and total CODs ; f) the metabolite productions and consumptions, for the R10 of Exp 2.

R12, Exp 2:

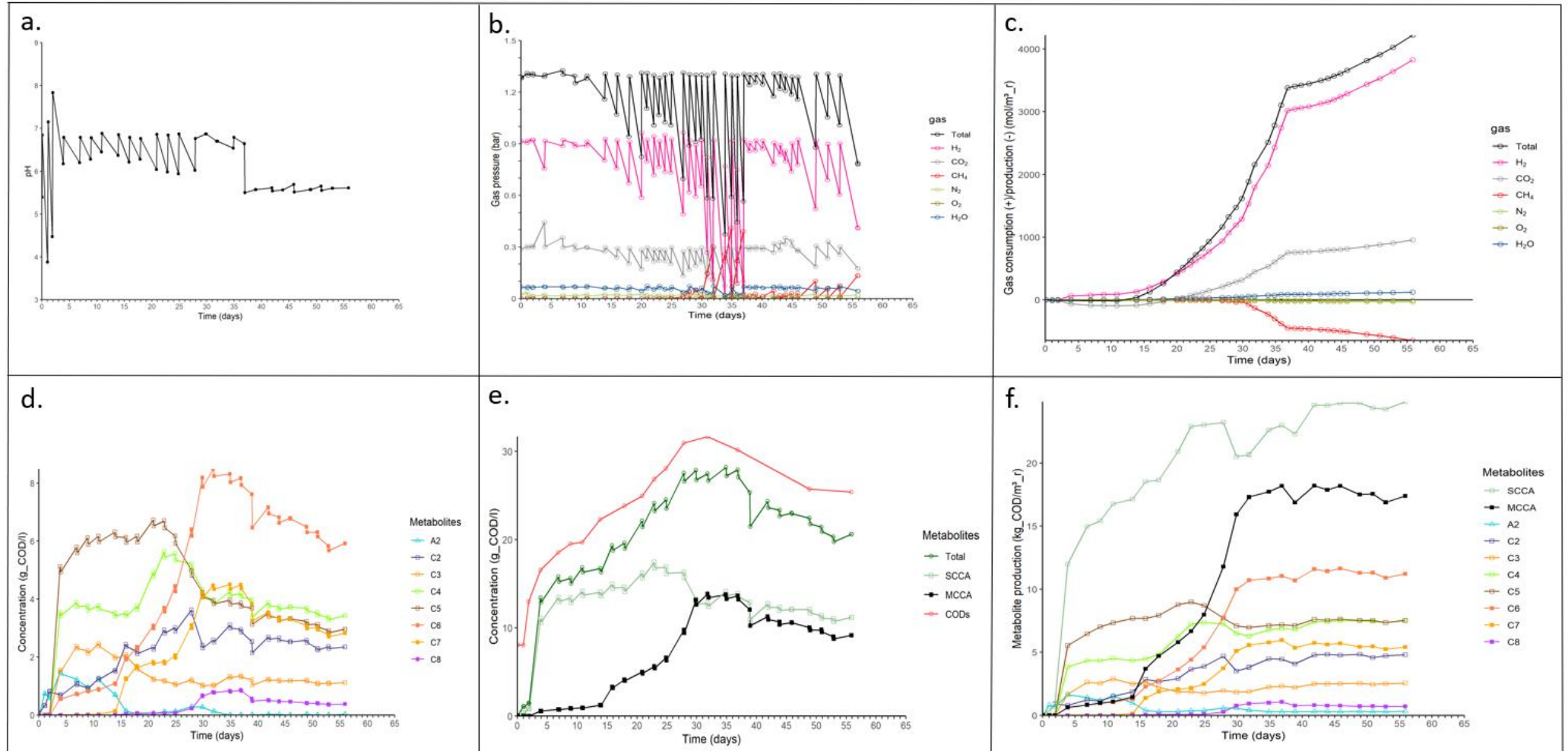


Figure XXIII: Evolution over time of a) the pH ; b) the gas partial pressures ; c) the gas productions and consumptions ; d) the individual metabolite concentrations ; e) the grouped metabolite concentrations and total CODs ; f) the metabolite productions and consumptions, for the R12 of Exp 2.

R13, Exp 2:

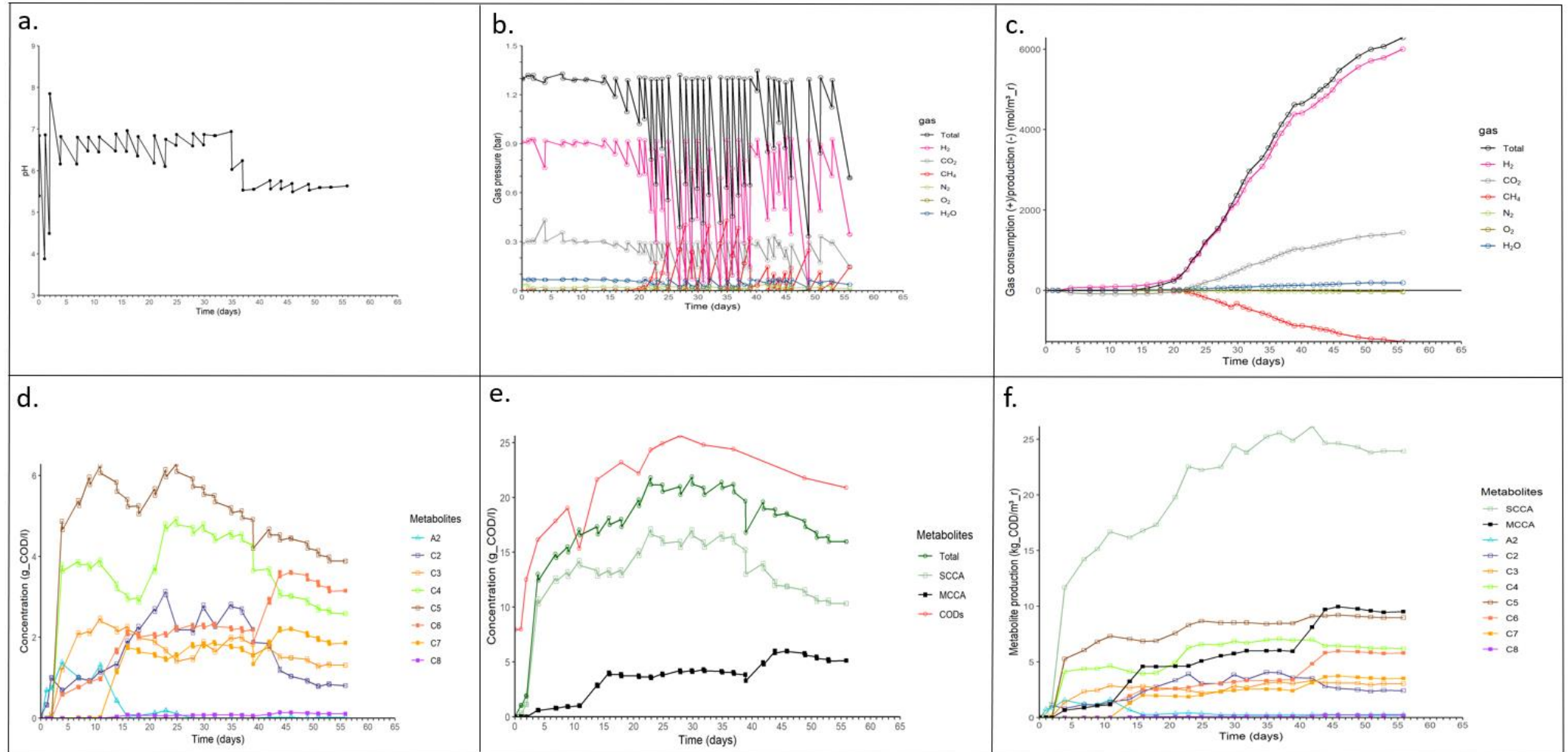


Figure XXIV: Evolution over time of a) the pH ; b) the gas partial pressures ; c) the gas productions and consumptions ; d) the individual metabolite concentrations ; e) the grouped metabolite concentrations and total CODs ; f) the metabolite productions and consumptions, for the R13 of Exp 2.

R14, Exp 2:

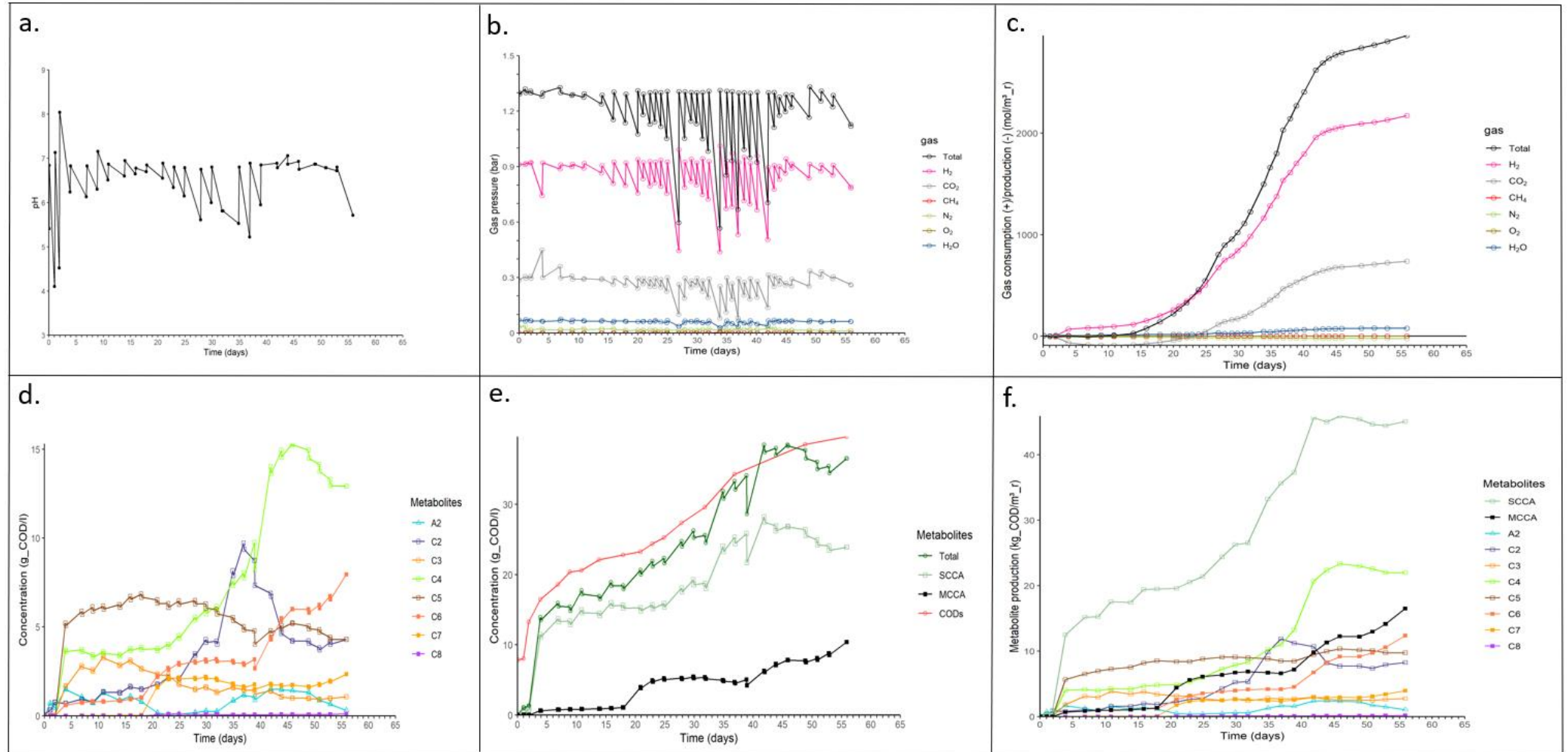


Figure XXV: Evolution over time of a) the pH ; b) the gas partial pressures ; c) the gas productions and consumptions ; d) the individual metabolite concentrations ; e) the grouped metabolite concentrations and total CODs ; f) the metabolite productions and consumptions, for the R14 of Exp 2.

R18, Exp 2:

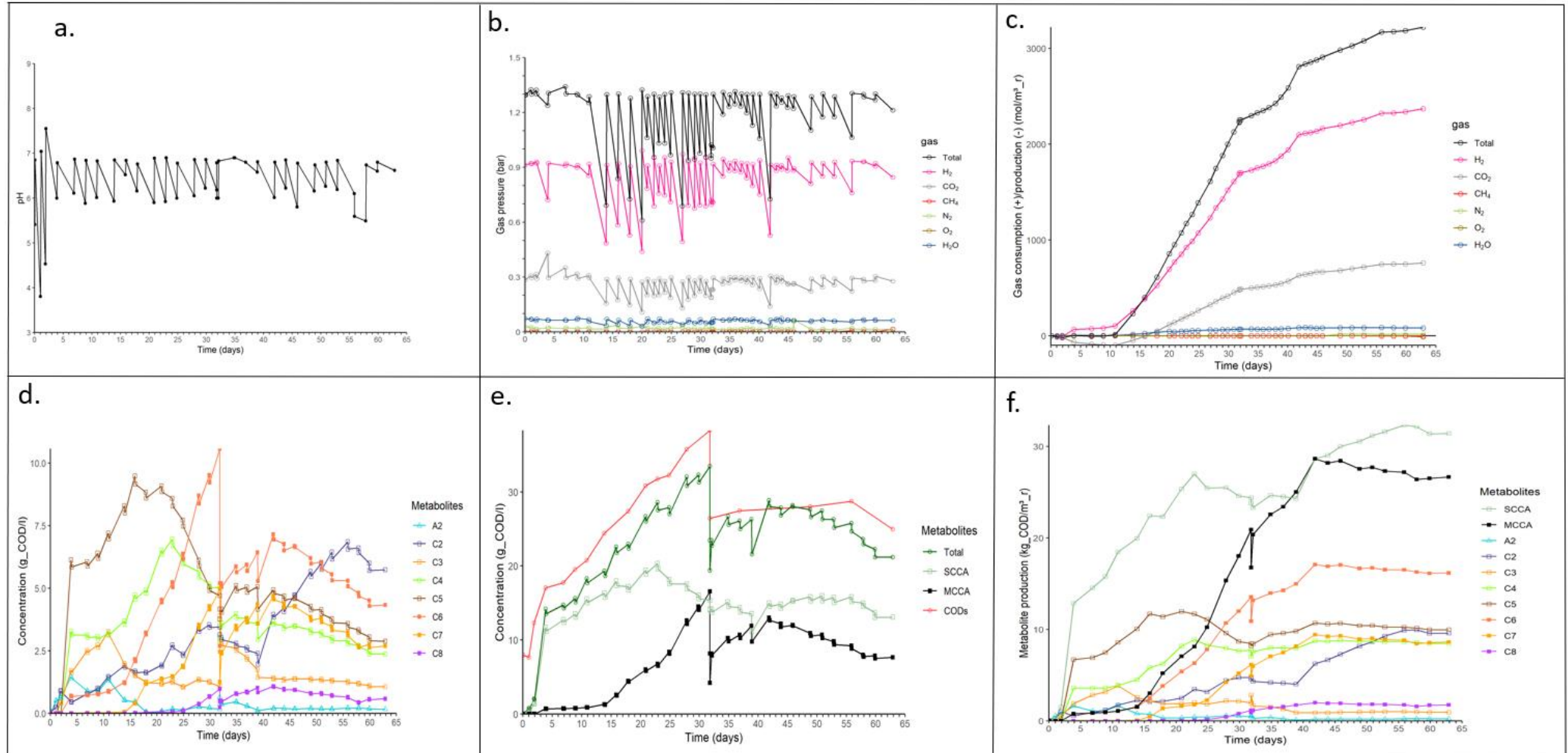


Figure XXVI: Evolution over time of a) the pH ; b) the gas partial pressures ; c) the gas productions and consumptions ; d) the individual metabolite concentrations ; e) the grouped metabolite concentrations and total CODs ; f) the metabolite productions and consumptions, for the R18 of Exp 2.

R19, Exp 2:

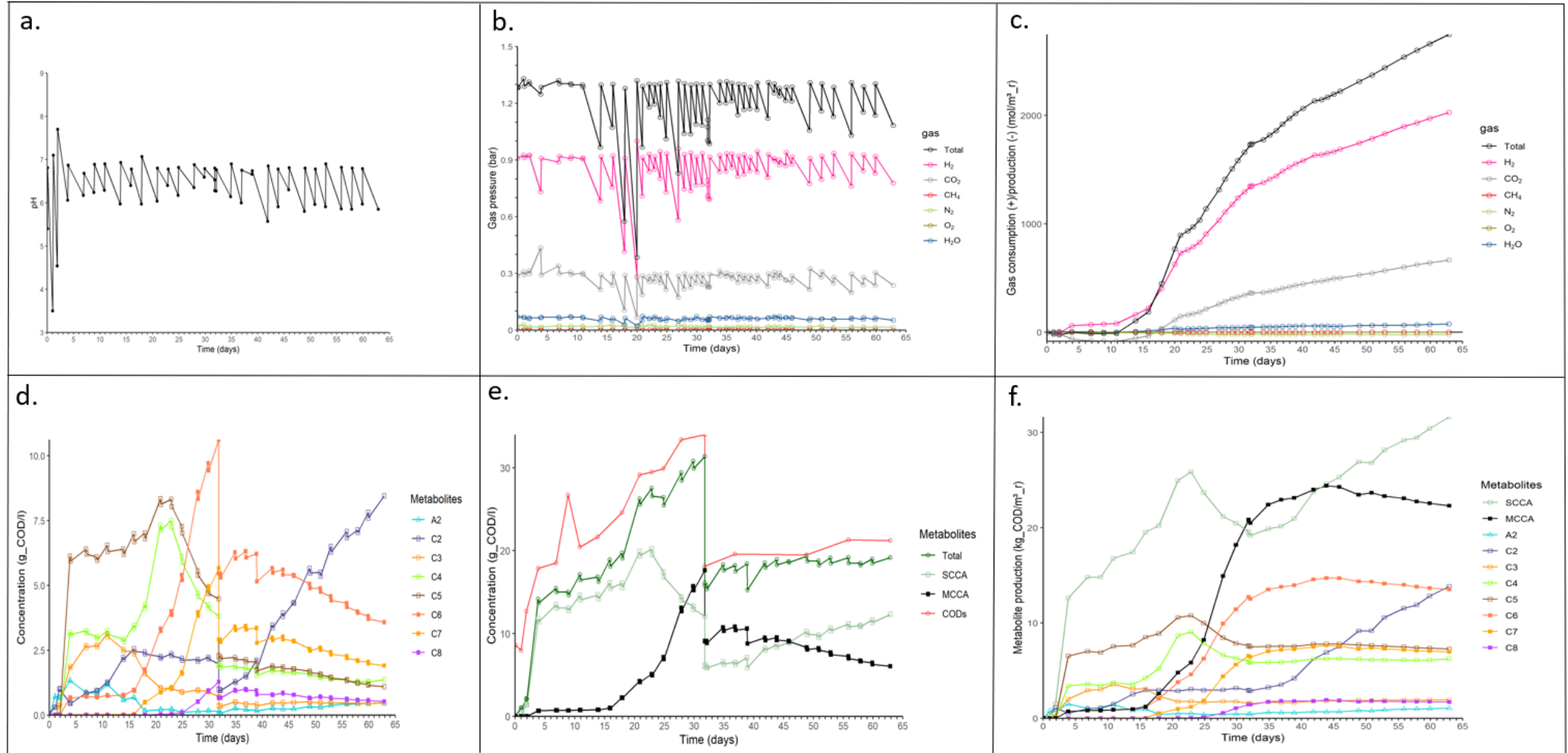


Figure XXVII: Evolution over time of a) the pH ; b) the gas partial pressures ; c) the gas productions and consumptions ; d) the individual metabolite concentrations ; e) the grouped metabolite concentrations and total CODs ; f) the metabolite productions and consumptions, for the R19 of Exp 2.

R20, Exp 2:

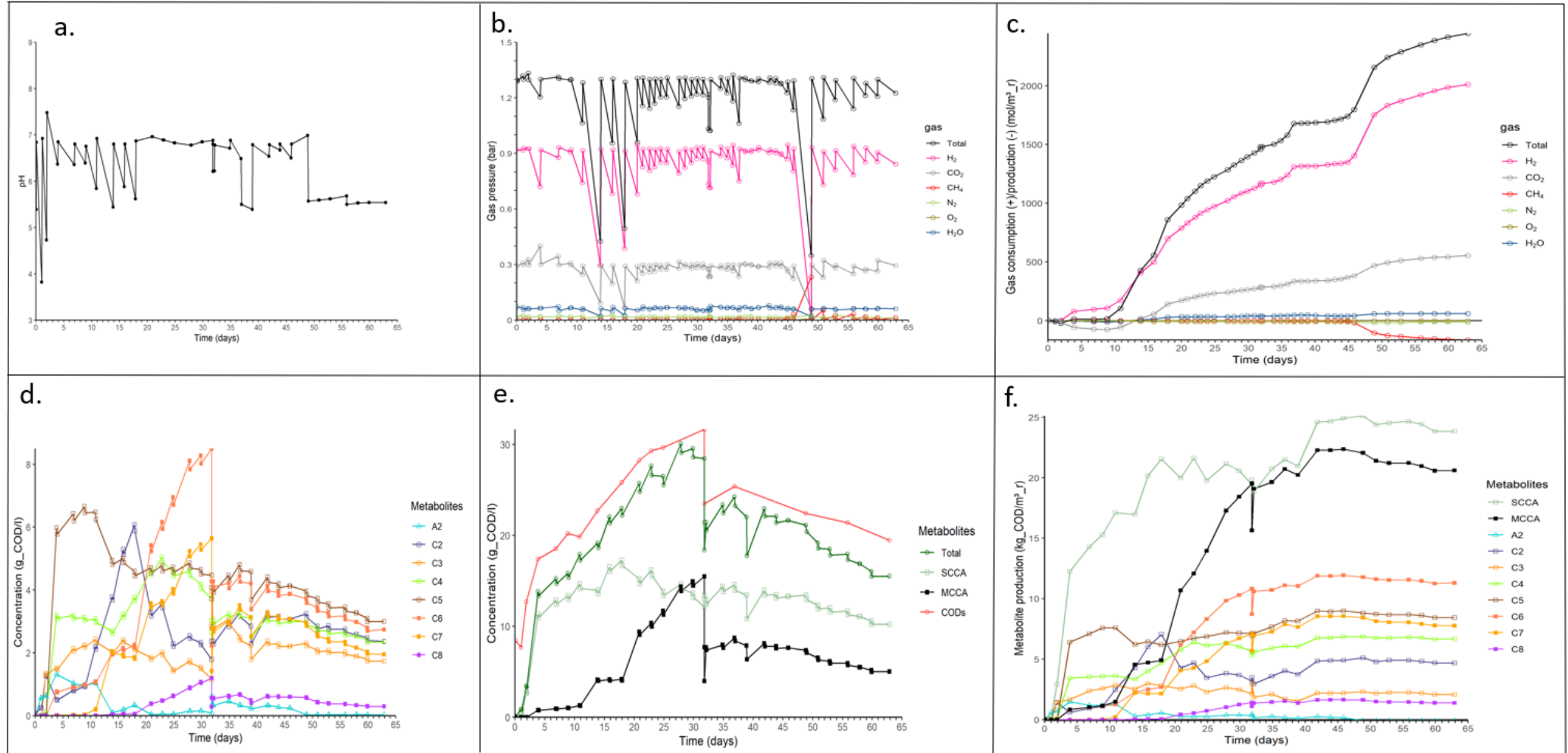


Figure XXVIII: Evolution over time of a) the pH ; b) the gas partial pressures ; c) the gas productions and consumptions ; d) the individual metabolite concentrations ; e) the grouped metabolite concentrations and total CODs ; f) the metabolite productions and consumptions, for the R20 of Exp 2.

R1, Exp 3:

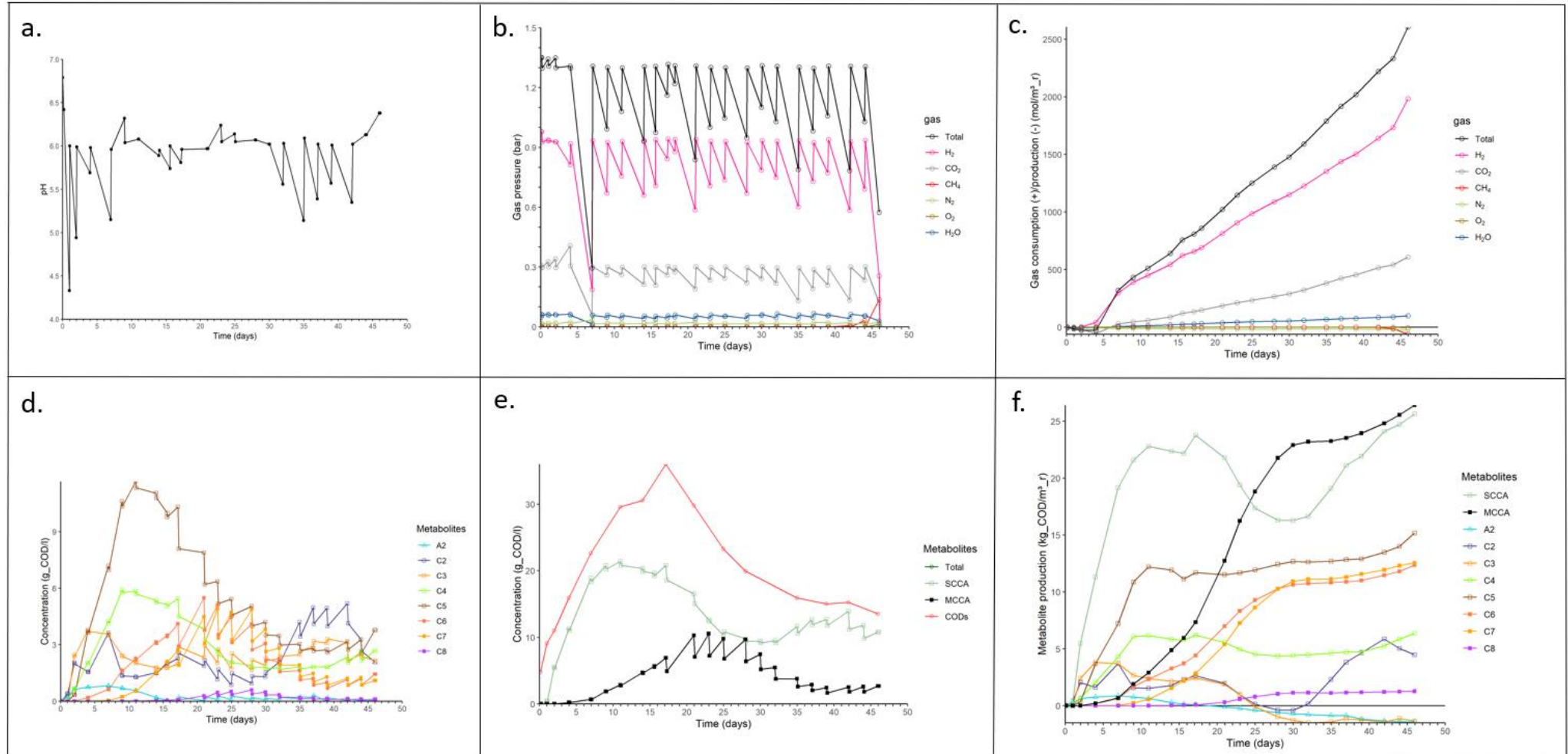


Figure XXIX: Evolution over time of a) the pH ; b) the gas partial pressures ; c) the gas productions and consumptions ; d) the individual metabolite concentrations ; e) the grouped metabolite concentrations and total CODs ; f) the metabolite productions and consumptions, for the R1 of Exp 3.

R2, Exp 3:

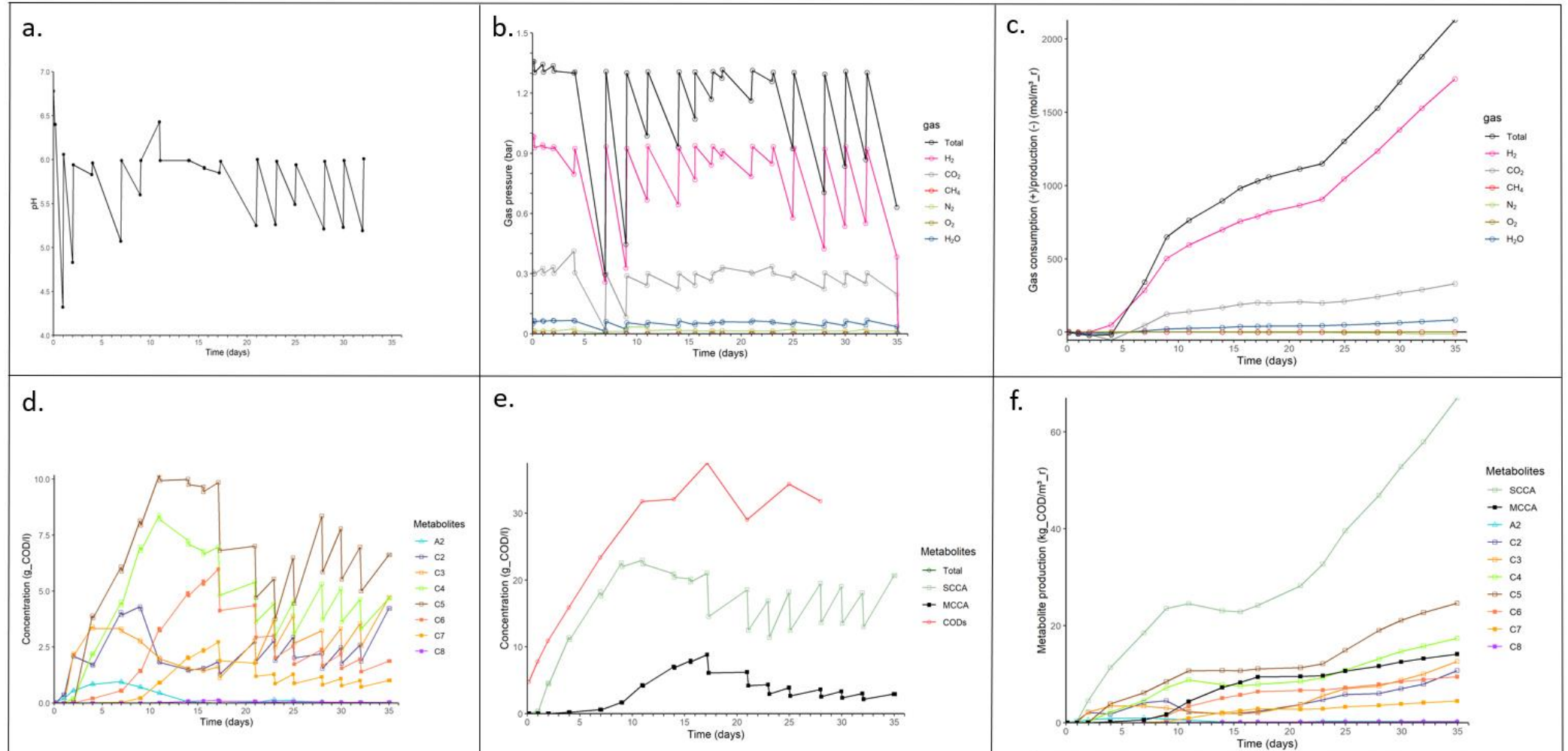


Figure XXX: Evolution over time of a) the pH ; b) the gas partial pressures ; c) the gas productions and consumptions ; d) the individual metabolite concentrations ; e) the grouped metabolite concentrations and total CODs ; f) the metabolite productions and consumptions, for the R2 of Exp 3.

R3, Exp 3:

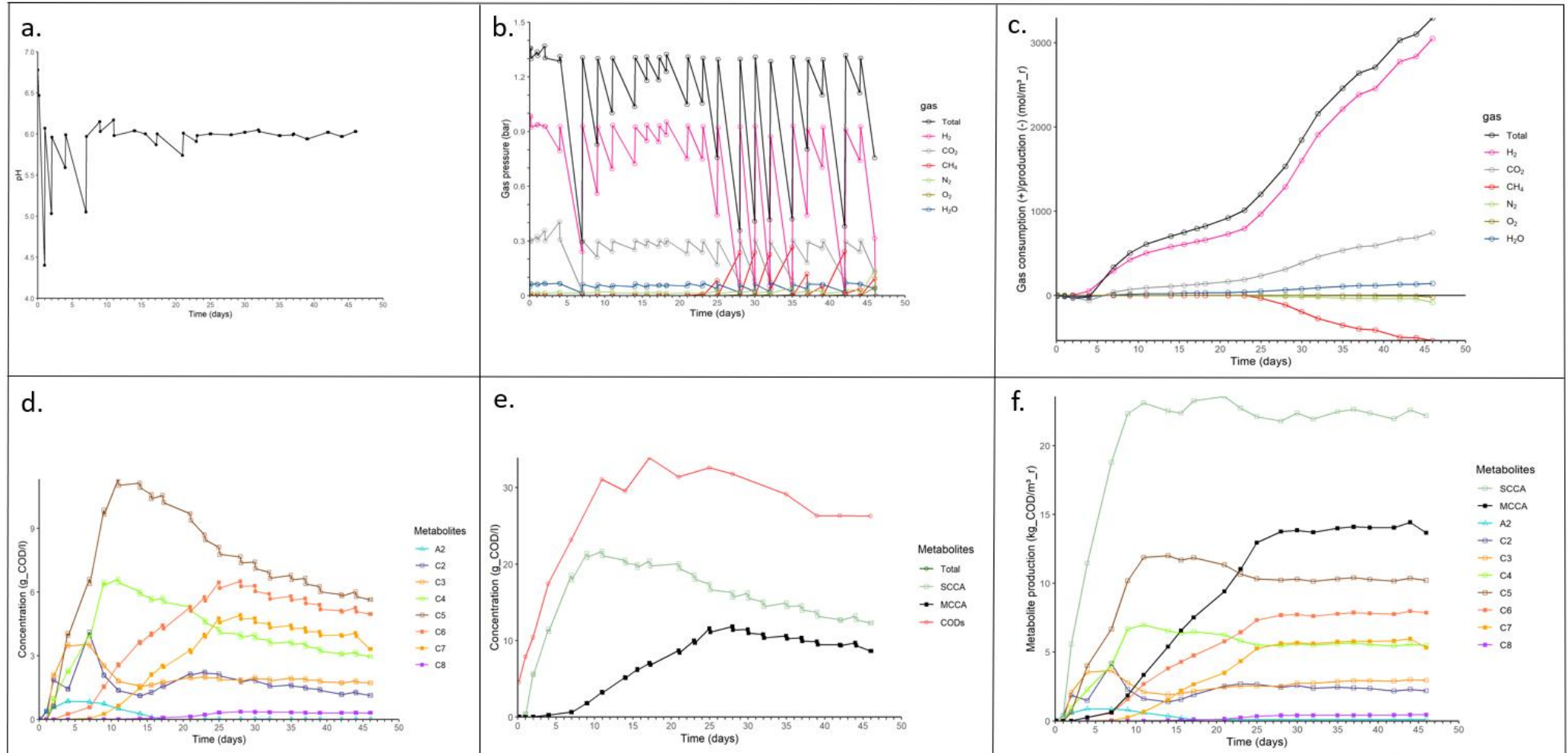


Figure XXXI: Evolution over time of a) the pH ; b) the gas partial pressures ; c) the gas productions and consumptions ; d) the individual metabolite concentrations ; e) the grouped metabolite concentrations and total CODs ; f) the metabolite productions and consumptions, for the R3 of Exp 3.

R4, Exp 3:

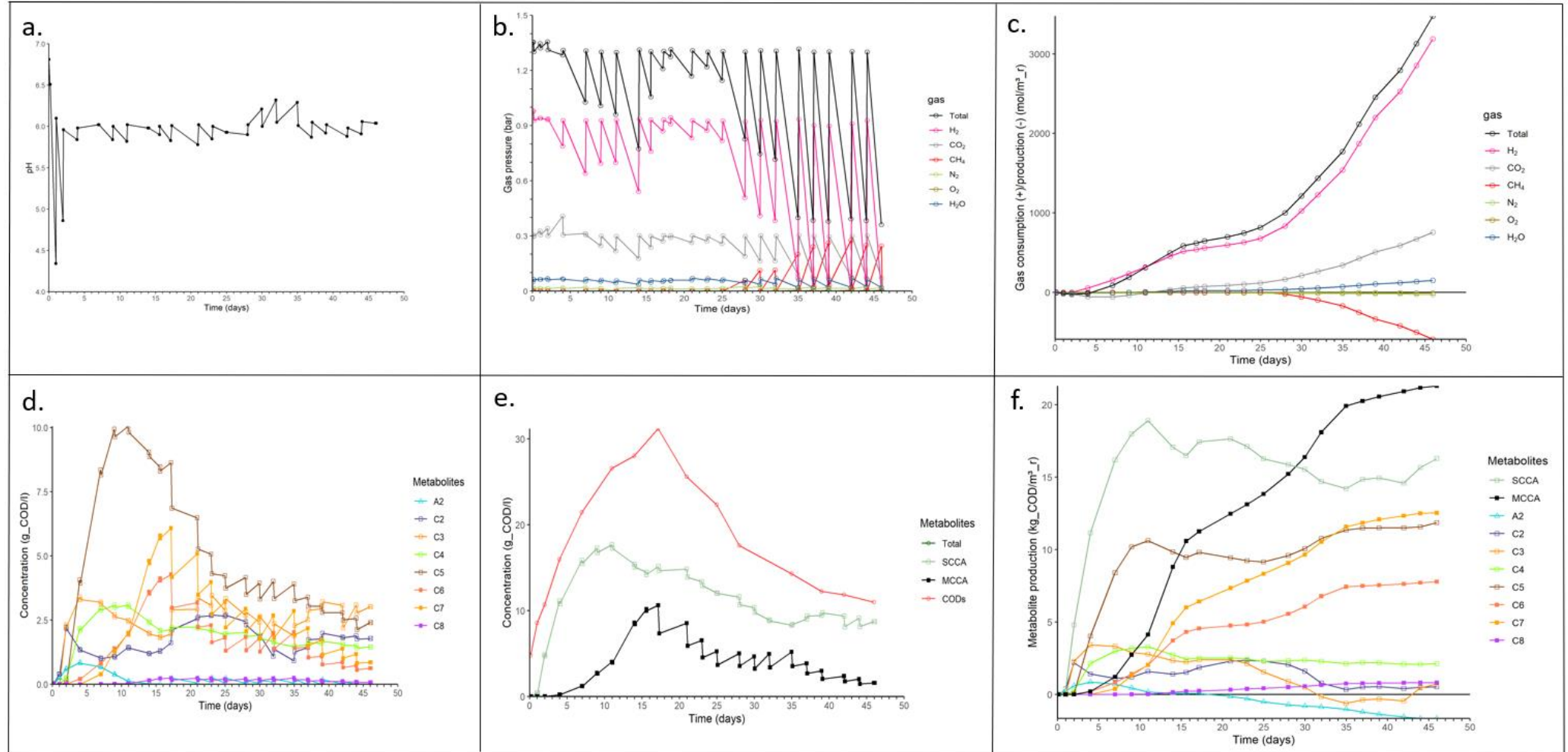


Figure XXXII: Evolution over time of a) the pH ; b) the gas partial pressures ; c) the gas productions and consumptions ; d) the individual metabolite concentrations ; e) the grouped metabolite concentrations and total CODs ; f) the metabolite productions and consumptions, for the R4 of Exp 3.

R5, Exp 3:

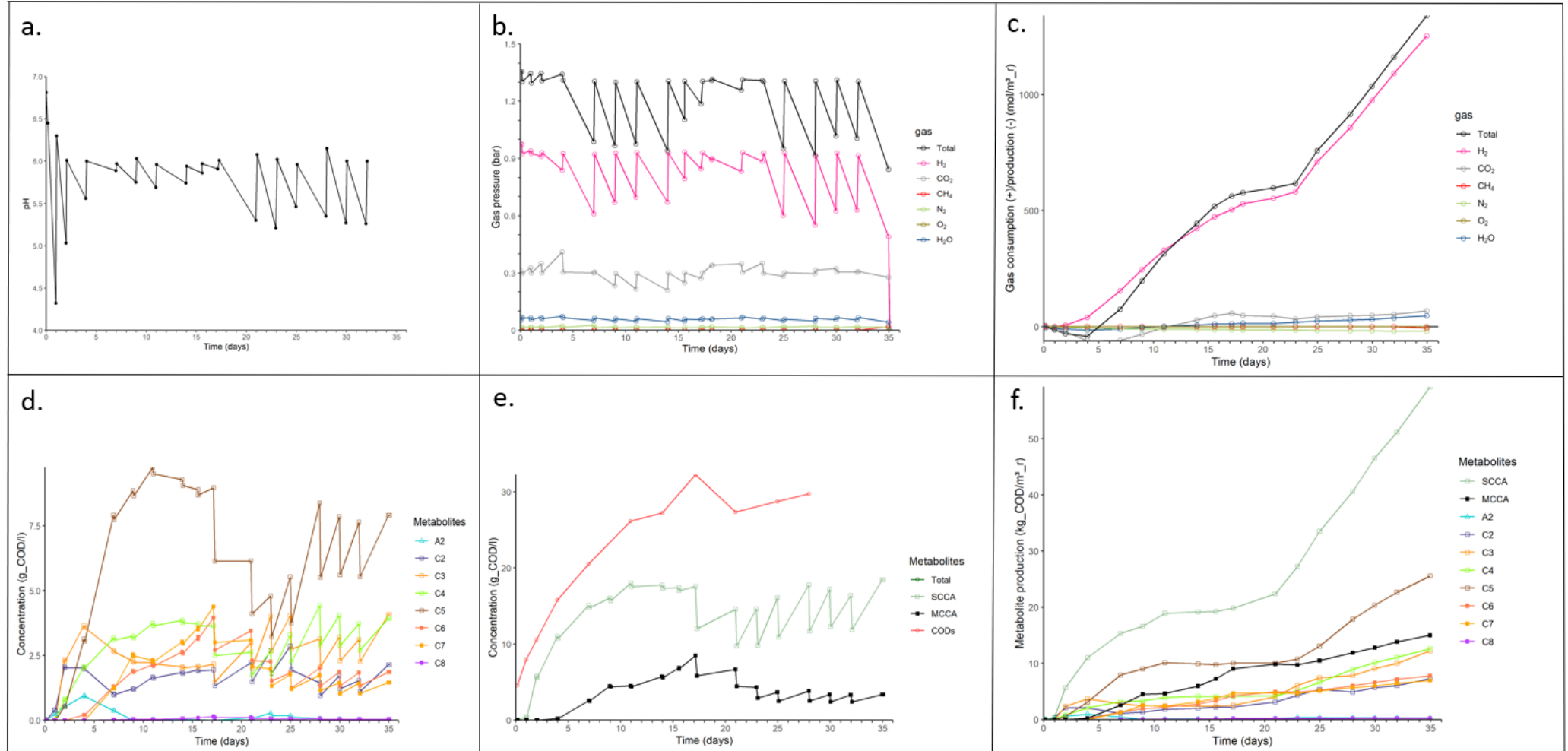


Figure XXXIII: Evolution over time of a) the pH ; b) the gas partial pressures ; c) the gas productions and consumptions ; d) the individual metabolite concentrations ; e) the grouped metabolite concentrations and total CODs ; f) the metabolite productions and consumptions, for the R5 of Exp 3.

R6, Exp 3:

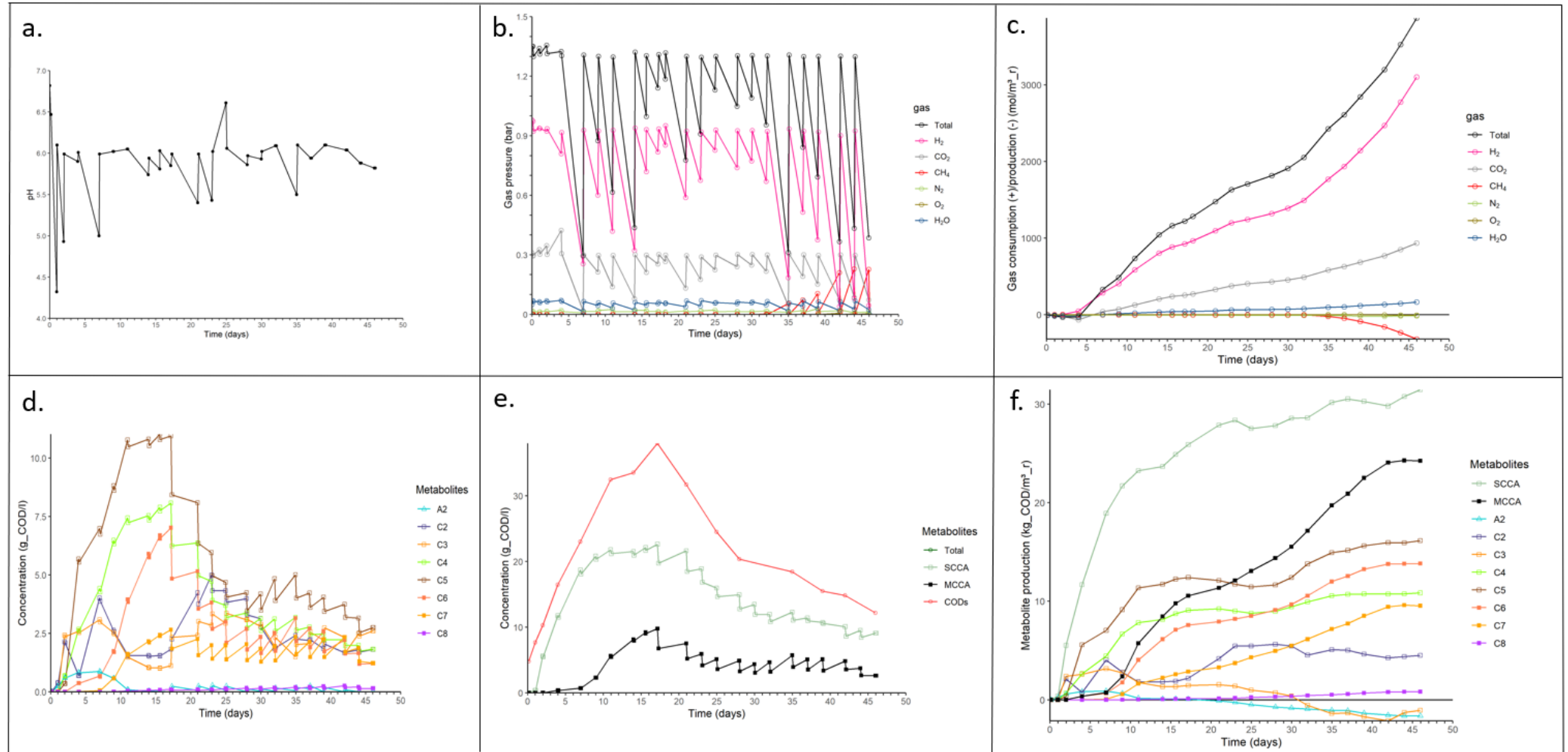


Figure XXXIV: Evolution over time of a) the pH ; b) the gas partial pressures ; c) the gas productions and consumptions ; d) the individual metabolite concentrations ; e) the grouped metabolite concentrations and total CODs ; f) the metabolite productions and consumptions, for the R6 of Exp 3.

R7, Exp 3:

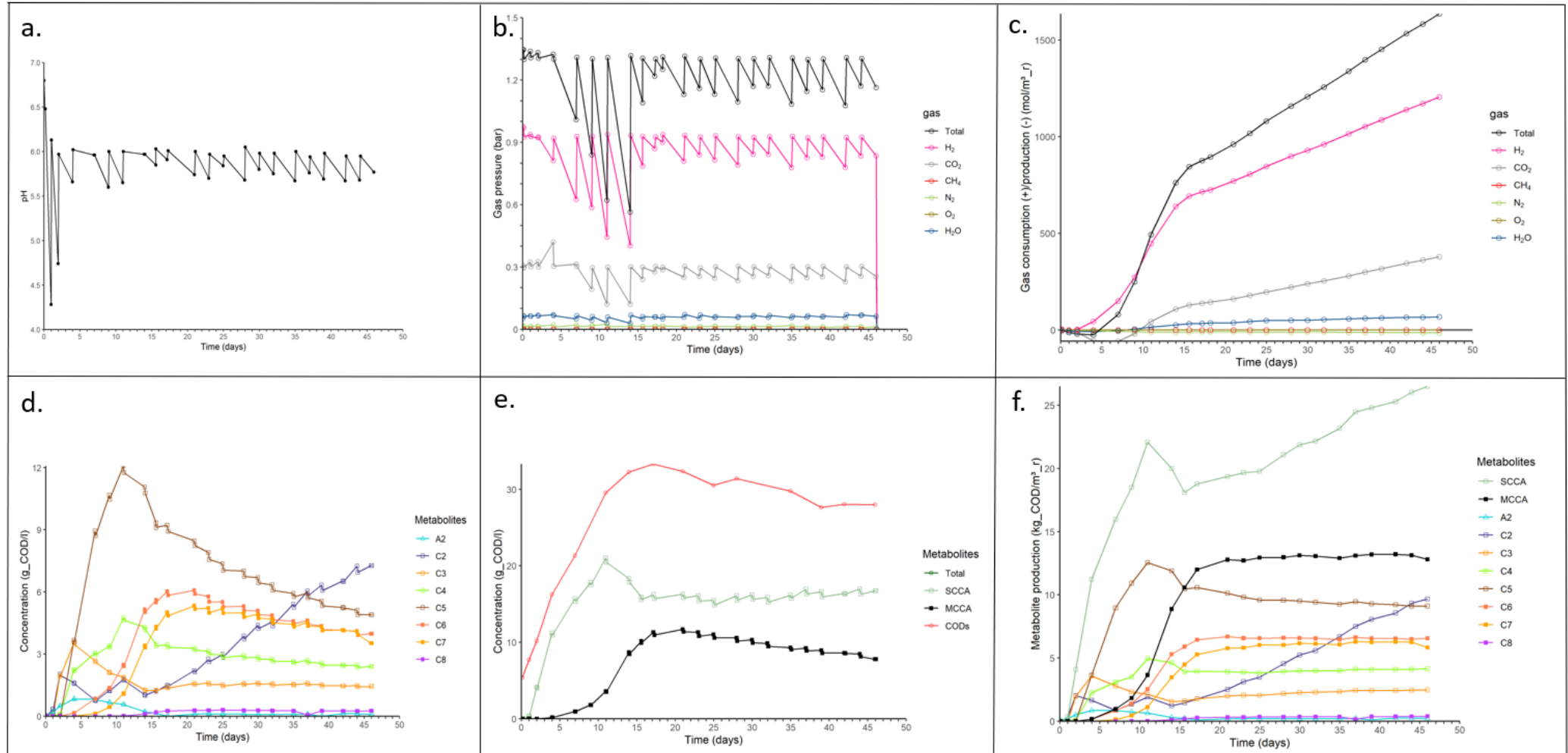


Figure XXXV: Evolution over time of a) the pH ; b) the gas partial pressures ; c) the gas productions and consumptions ; d) the individual metabolite concentrations ; e) the grouped metabolite concentrations and total CODs ; f) the metabolite productions and consumptions, for the R7 of Exp 3.

R8, Exp 3:

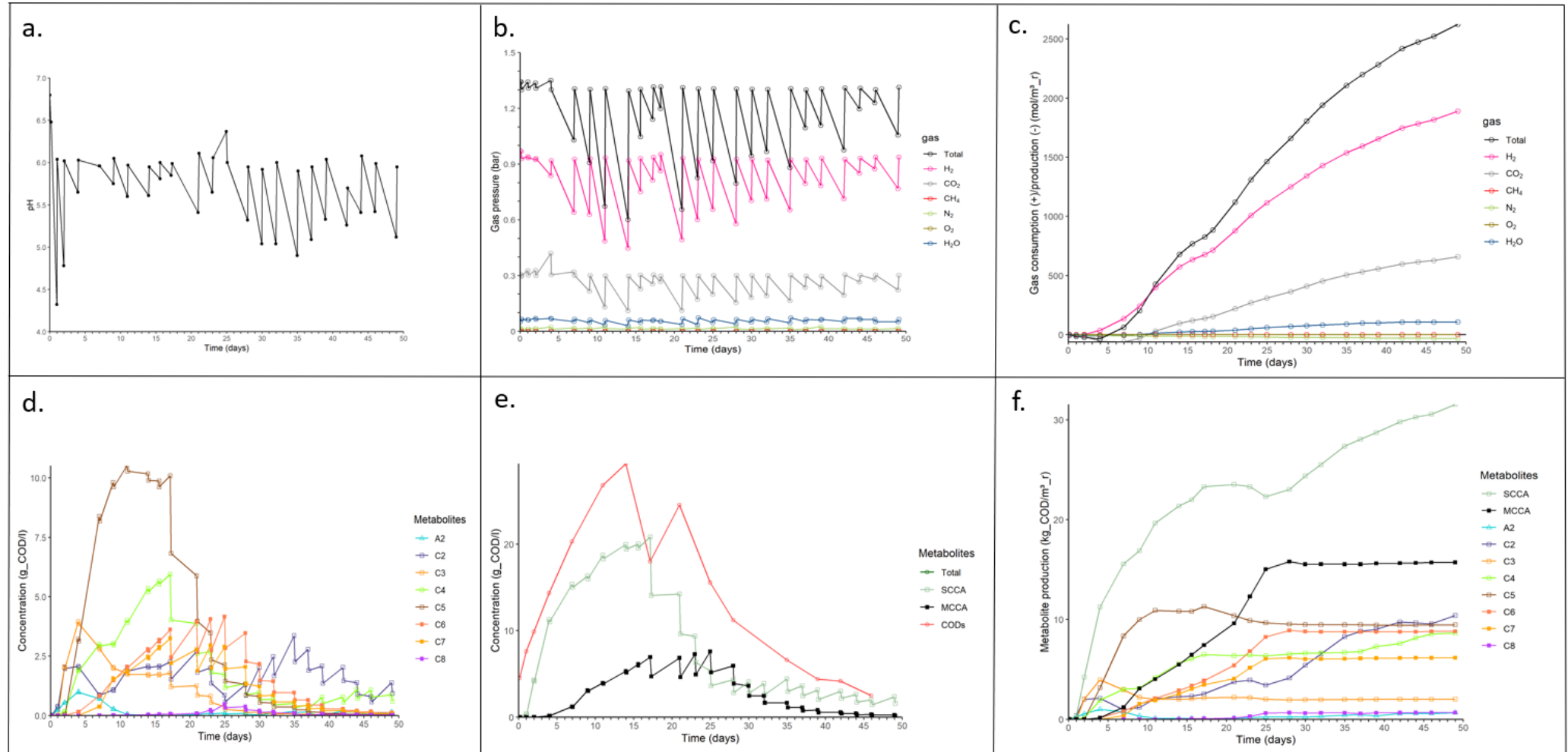


Figure XXXVI: Evolution over time of a) the pH ; b) the gas partial pressures ; c) the gas productions and consumptions ; d) the individual metabolite concentrations ; e) the grouped metabolite concentrations and total CODs ; f) the metabolite productions and consumptions, for the R8 of Exp 3.

R9, Exp 3:

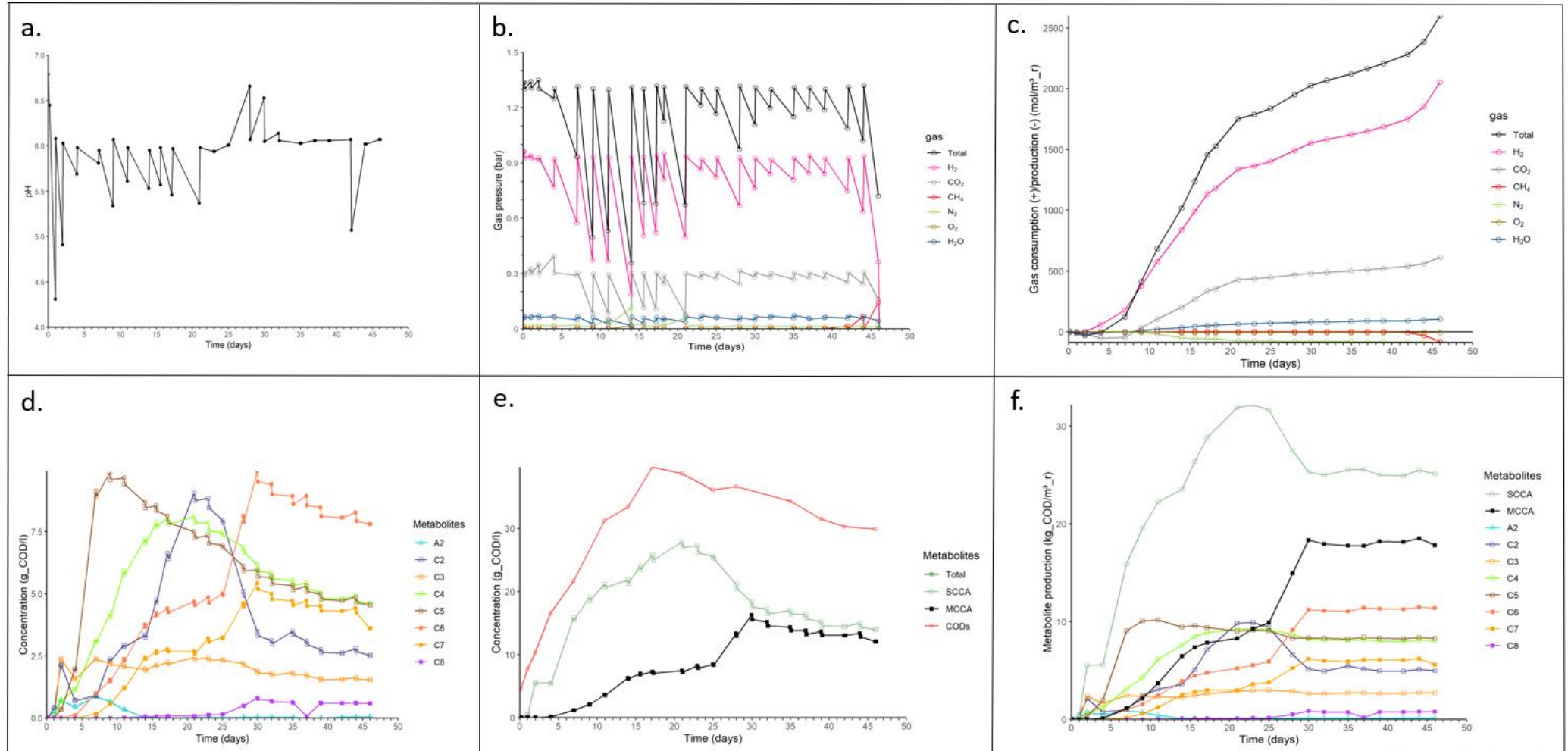


Figure XXXVII: Evolution over time of a) the pH ; b) the gas partial pressures ; c) the gas productions and consumptions ; d) the individual metabolite concentrations ; e) the grouped metabolite concentrations and total CODs ; f) the metabolite productions and consumptions, for the R9 of Exp 3.

R10, Exp 3:

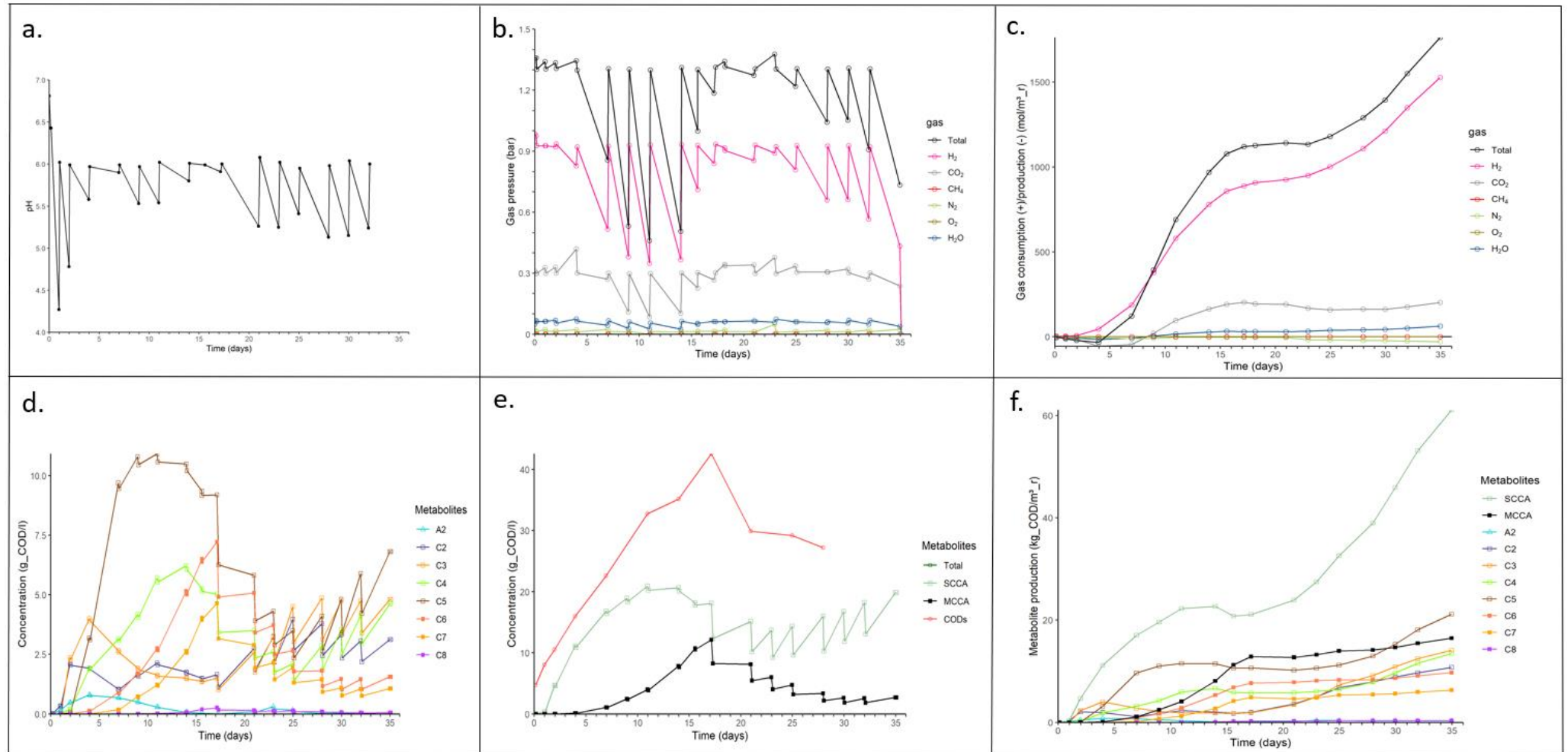


Figure XXXVIII: Evolution over time of a) the pH ; b) the gas partial pressures ; c) the gas productions and consumptions ; d) the individual metabolite concentrations ; e) the grouped metabolite concentrations and total CODs ; f) the metabolite productions and consumptions, for the R10 of Exp 3.

R11, Exp 3:

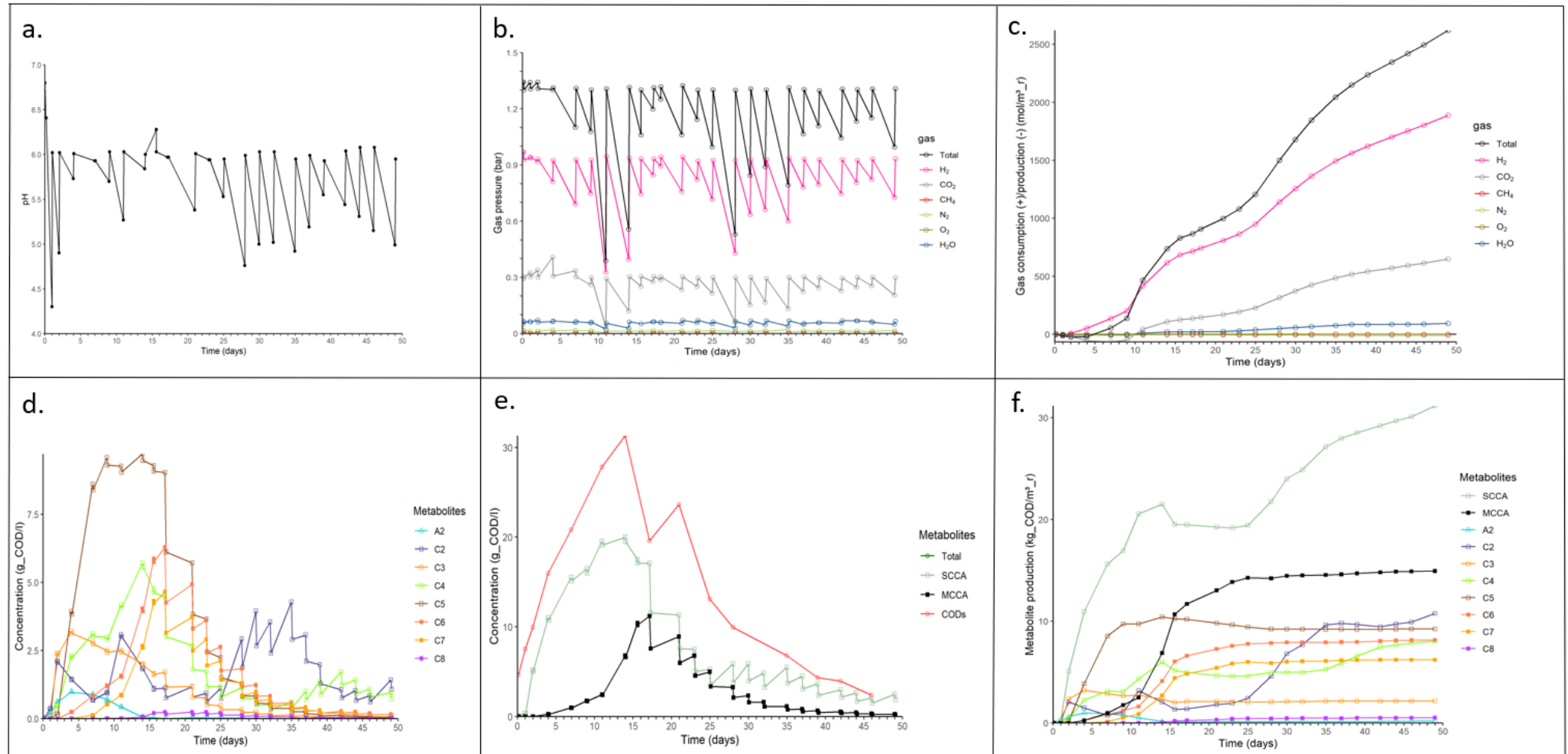


Figure XXXIX: Evolution over time of a) the pH ; b) the gas partial pressures ; c) the gas productions and consumptions ; d) the individual metabolite concentrations ; e) the grouped metabolite concentrations and total CODs ; f) the metabolite productions and consumptions, for the R11 of Exp 3.

R12, Exp 3:

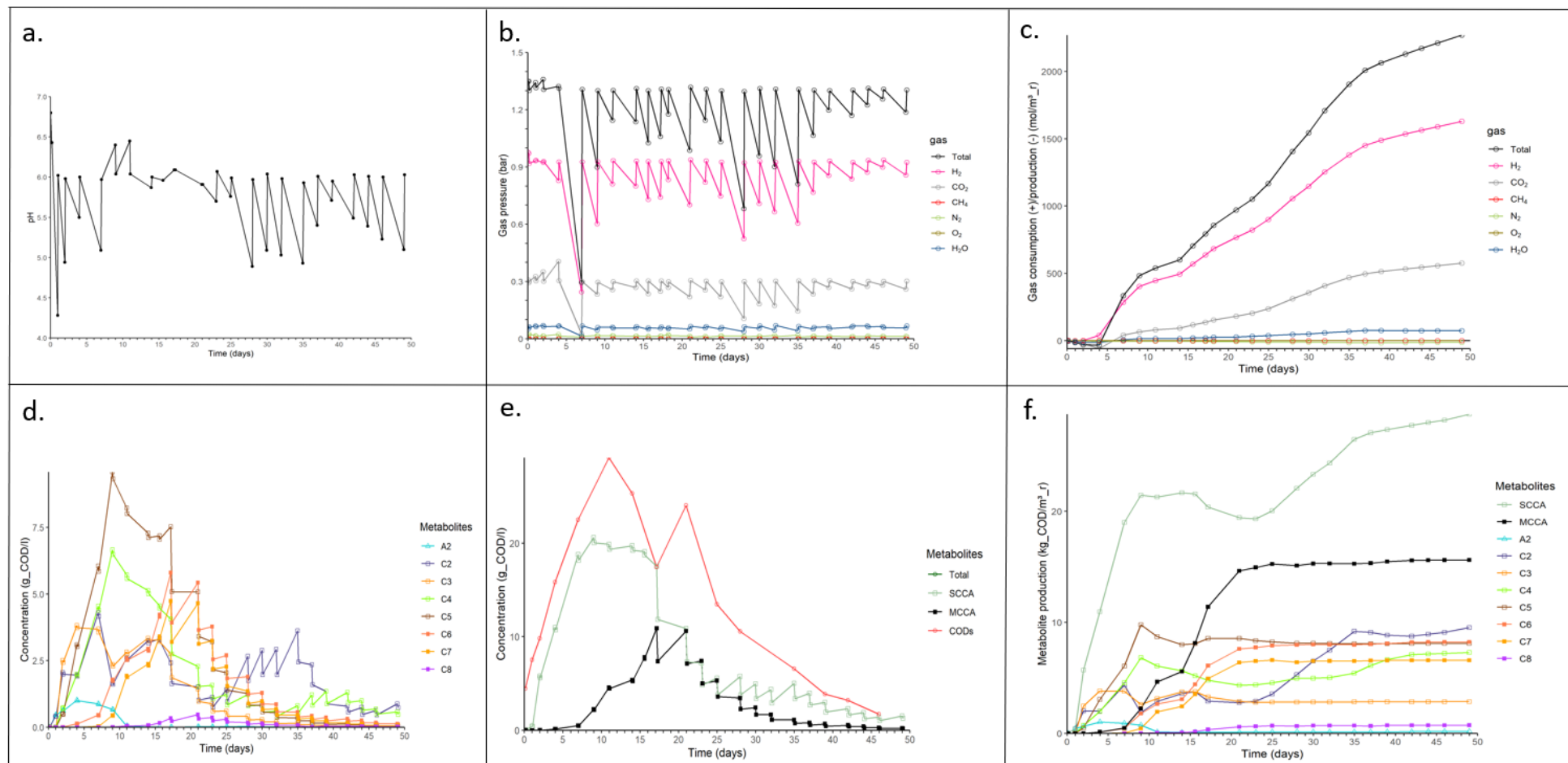


Figure XL: Evolution over time of a) the pH ; b) the gas partial pressures ; c) the gas productions and consumptions ; d) the individual metabolite concentrations ; e) the grouped metabolite concentrations and total CODs ; f) the metabolite productions and consumptions, for the R12 of Exp 3.