Carbohydrases influence nutrient degradability along digestive tract and fermentation patterns

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Objective

Simulate the digestive process of pig

Isolate individual effect of pure raw material (cereal/byproduct and protein meal)

Identified enzyme effect location

Materials and methods

In-vitro digestibility adapted from Boisen and Fernandez (1997) : pepsic (0.75h); pancreatic (2.00h) phase

Fermentation were simulated in Automatic pressure evaluation system (APES) fro a period of 72h

Statistics and calculation

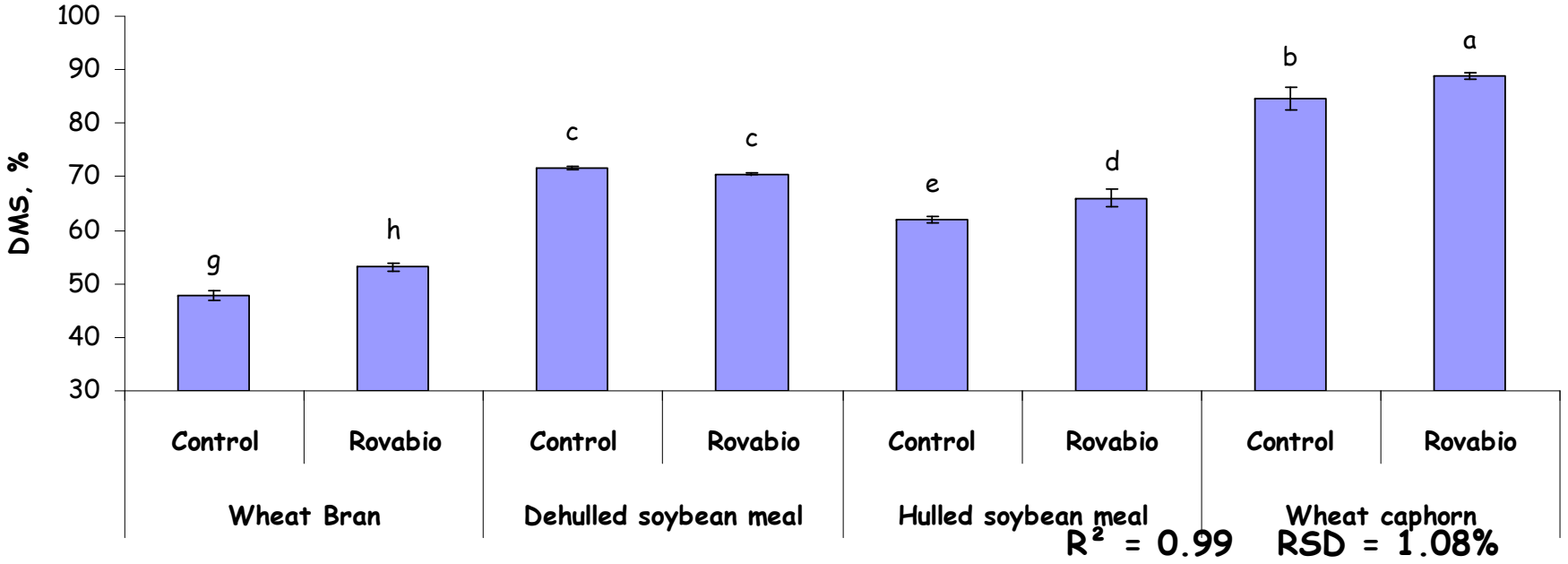
Factorial design, variance analysis performed on dry matter degradability and volatile fatty production with raw material (n=4), enzyme (n=2) and interaction as fixed effects

Total gas production is modelized according de Groots model

(Y = c / (1+exp(-a(time-b))))

- Where a= growth; b= lag time; c= asymptote

Raw material/enzyme affect ileal degradability



- Raw material fiber content affect dry matter digestibility

  Wheat bran ⇔ Wheat
  Hulled soybean meal ⇔ Dehulled soybean meal

- Enzyme was most efficient on raw material with highest fiber content

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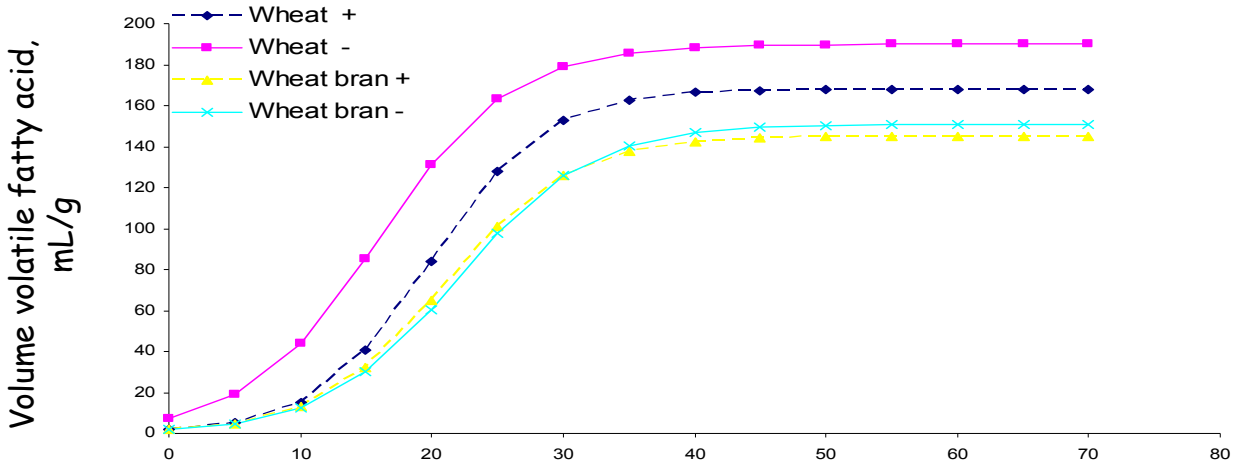
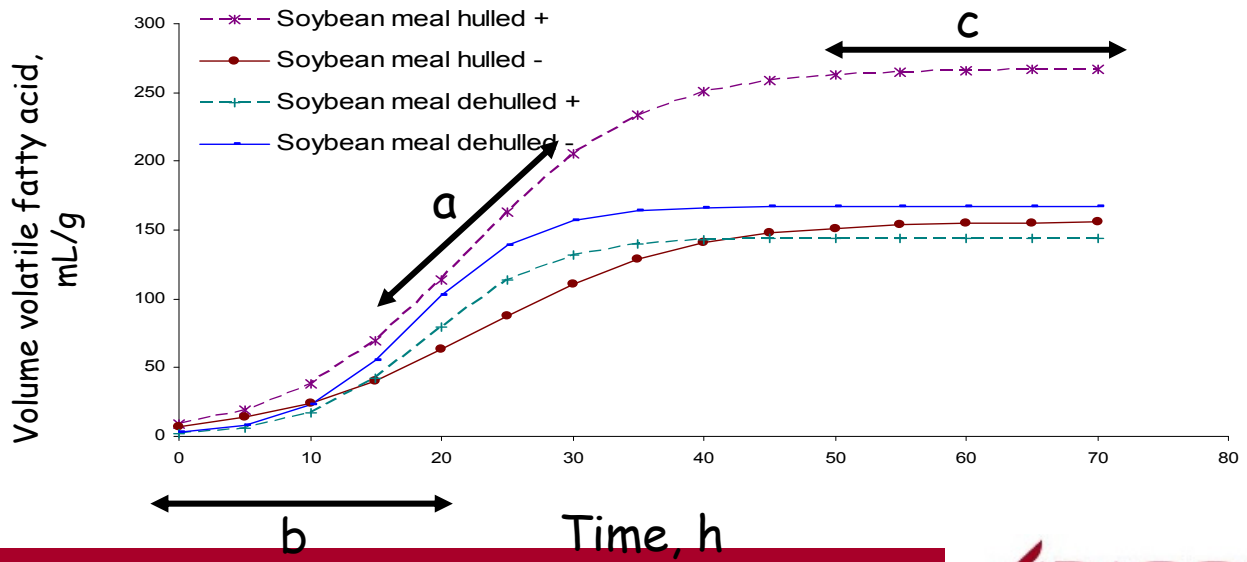
NSP-enzymes modify fermentation rate

In vitro incubation : pig fecal + raw materials digested +/- NSP-enzymes





NSP-enzymes modify the fermentation

Raw material	Wheat		Wheat bran		Soybean meal				Statistics		
					hulled		dehulled		P values		
enzyme	+	-	+	-	+	-	+	-	material	enz	inter
Kinetic											
a	0.23	0.20	0.21	0.20	0.15	0.13	0.22	0.23	< 0,0001	0.073	0.340
b	20	16	21	22	22	23	19	18	< 0,0001	0.070	0.013
c	168	190	145	151	267	156	144	167	< 0,0001	0.073	< 0,0001
Volatile fatty acid, %											
Total	0.31	0.33	0.27	0.29	0.53	0.35	0.30	0.38	< 0,0001	0.311	< 0,0001
Acetic acid	0.16	0.17	0.14	0.15	0.31	0.21	0.15	0.20	< 0,0001	0.329	< 0,0001
Butyric acid	0.05	0.05	0.04	0.05	0.06	0.03	0.04	0.05	0.139	0.042	< 0,0001
isoButyric	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.001	0.521	0.135
isoValeric	0.01	0.01	0.01	0.01	0.01	0.00	0.01	0.01	< 0,0001	0.206	0.009
Propionic acid	0.08	0.10	0.07	0.08	0.14	0.10	0.08	0.10	< 0,0001	0.709	0.006
Valeric acid	0.01	0.01	0.01	0.01	0.01	0.00	0.01	0.01	0.005	0.004	0.000
Ammonia	10.2	10.2	11.3	12.0	10.2	9.3	13.7	11.5	<0,0001	0.114	0.024

a= growth
b= lag time
c= asymptote

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Conclusions

- **Raw material composition and additive affect digestive process**
  - Among of feed reaching the hindgut ranged from 15 to 53%
  - Enzyme increase the digestibility with more marked effect with rich fiber raw material wheat bran and hulled soybean meal (+6% units)
- **Remaining raw material**
  - V max increase with Rovabio for wheat and soybean meal hulled
  - Increase of total gas production for soybean meal hulled with Rovabio
  - Slight reduction of total gas production for wheat with Rovabio
- **Volatile Fatty acid**
  - Raw material affect AGV profile with highest amount acetic and propionic acid for hulled soybean
  - Enzyme addition increase modulate overall profil of AVG (R^2 = 0.99)
  - More important change were observed in this study for hulled soybean meal with increase of profile by 28% with enzyme