# Effect of microbial consortia from wild herbivores on goat rumen fibrolytic activity and browse fermentation

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# Overview of research

# **Introduction**

➢ Livestock ~ 33 % the total protein in human diets

➢ Demand for meat as a protein source increases yearly

➢ Due to the increasing human population

# Introduction…

- ➢ World's human population is about 7.4 billion (United Nations, 2016)

- ➢ Africa contributing ~ 16.4% = 1.2 billion

- ➢ World's Growth rate = 1.3%/yr = 81.9 million

- ➢ Africa growth rate = 2.53%/yr = 22.5 million
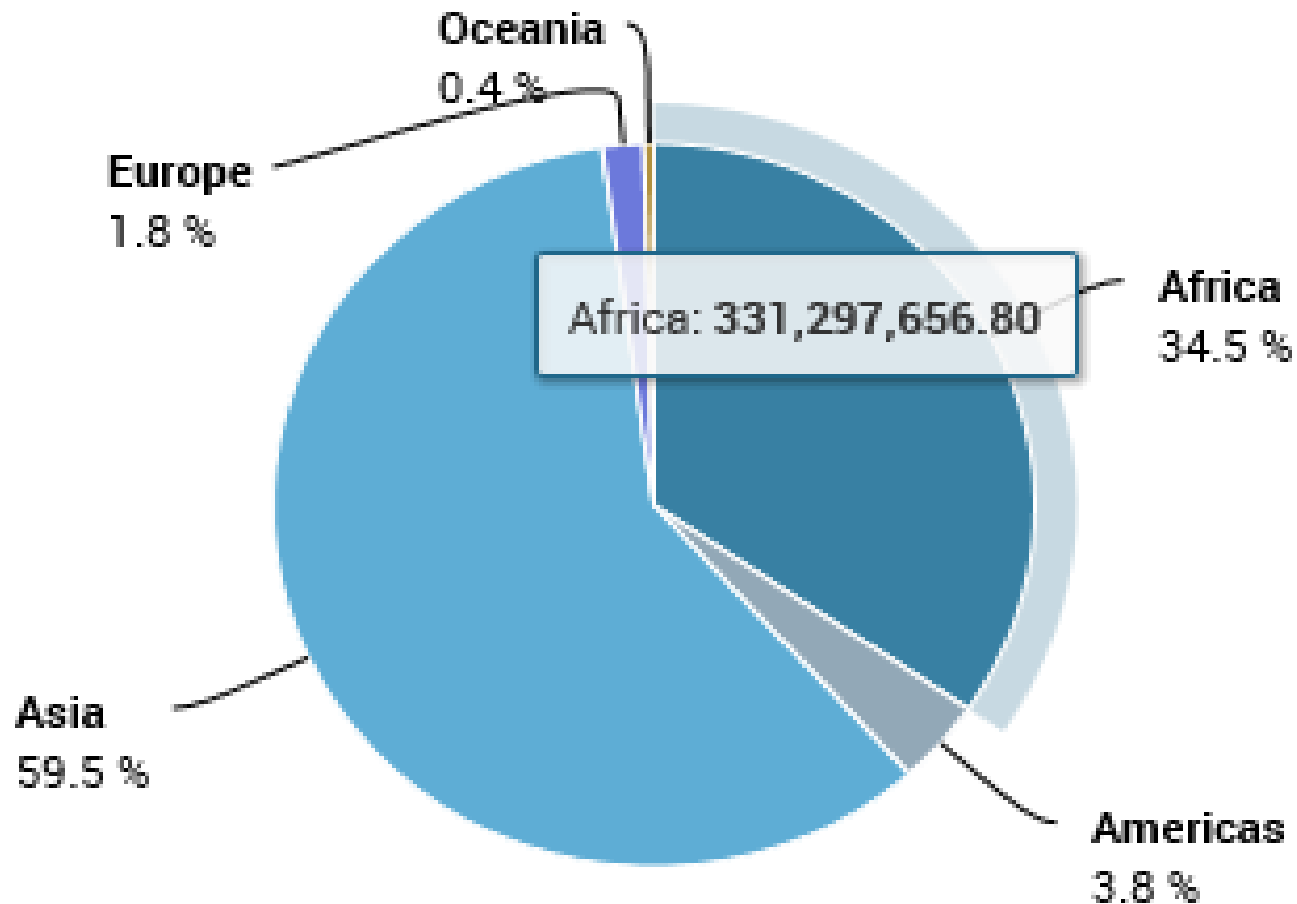
- ➢ Europe growth rate = 0.06%/yr = 2.7 million

# Introduction…

➢ **Population wise = problem severe in Africa**

➢ **where majority of the population rely on livestock for protein supply**

    ➢**Because plant protein sources are scarce, Why?**

➢ **Implies livestock production needs to increase**

➢ **To sustain the rapidly increasing human population especially in Africa**
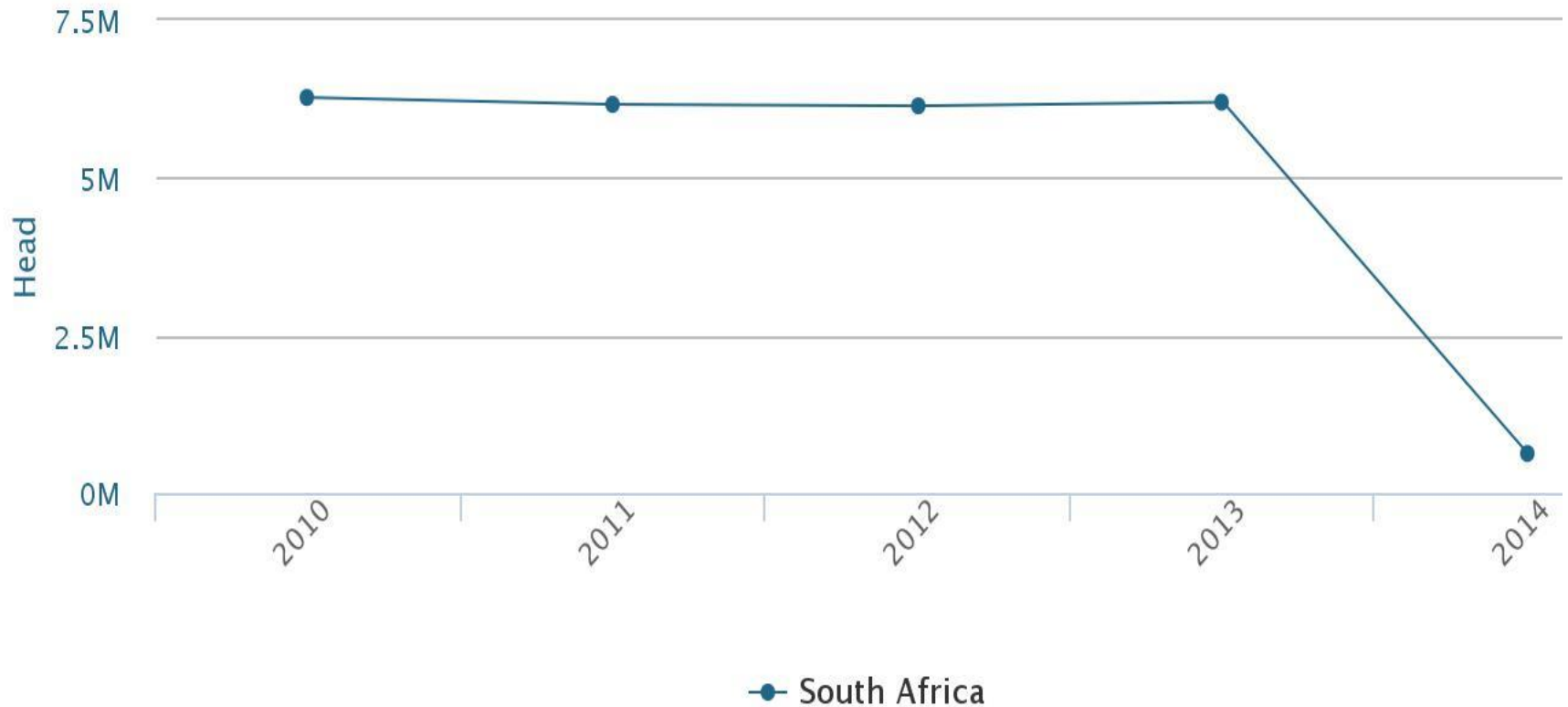
# Livestock contribution

|  | Metric ton | Percentage |
|---|---|---|
| Beef and veal | 58 922 239 | 23% |
| Mutton and lamb | 8 025 027 | 3% |
| Goat meat | 4 198 885 | 2% |
| Pork | 98 506 662 | 39% |
| Chicken meat | 65 014 504 | 26% |
| Other | 18 860 683 | 7% |

# Continents goat production



Oceania
0.4 %

Europe
1.8 %

Africa: 331,297,656.80

Africa
34.5 %

Asia
59.5 %

Americas
3.8 %

# Goat production in South Africa



M = Million, k = Thousand

Fat supply quantity (g/capita/day)  Protein supply quantity (g/capita/day)
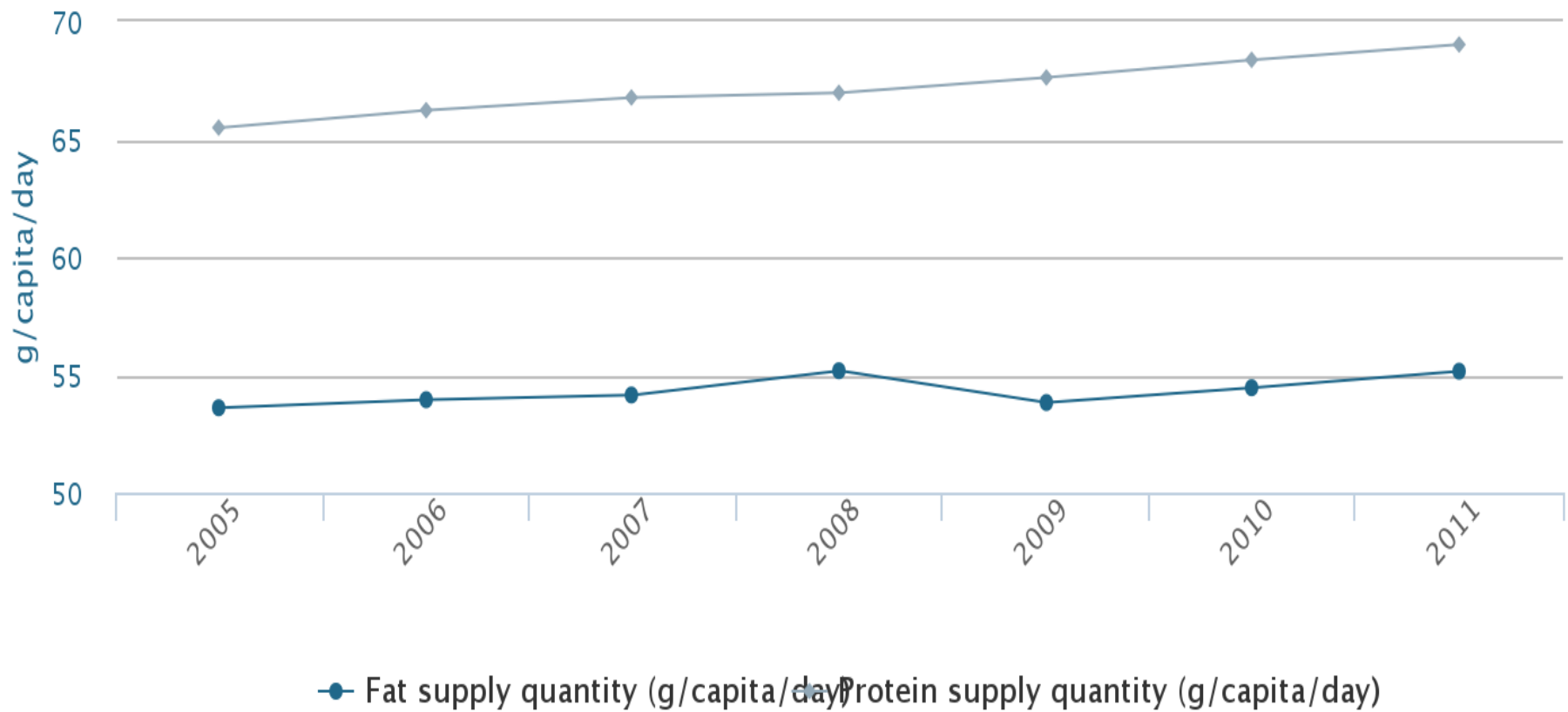
M = Million, k = Thousand

FAOSTAT, 2016

# **Question**: Why the drop in number?

- Obvious answer: Not enough forage or browses?

- But the survive hash winter?

- What about efficiency of **browse utilization**?

- Good quantity still flows out as waste?

- Poor microbial/enzyme activities (cellulases)

- Presence of microbial toxins (phenolic compounds/ condensed tannins)

- **Objective of research**

- Evaluate the effect of microbial inocula from wild herbivores (impala, kudu and giraffe) on *in vitro* fermentation and cellulases activities of domestic goats.

# Material and Methods

**Sample collection**

➢ Goat (GT)

➢ Impala (IM),

➢ Kudu (KD)

➢ Giraffe (GF)

# Material and Methods ...

• **Faecal inoculum preparation**

• **Individual ecosystems (GT, IM, KD and GF)**

- **-100 g feces + 100 ml salivary buffer**

- **-Squeezed through 4 layers cheese cloth**

# Material and Methods ...

• **Inoculum culturing**

•**For the combined ecosystems fecal inoculum;**

  ➢ N0=  Goat

  ➢ N1 =  (goat +impala, 16.5:16.5 mL),

  ➢ N2 =  (goat + kudu, 16.5:16.5 mL),

  ➢ N3  =  (goat + giraffe + kudu, 11:11:11 mL)

  ➢ N4 =   (goat + giraffe + kudu + impala, 8.25: 8.25: 8.25: 8.25 mL).

# Material and Methods …
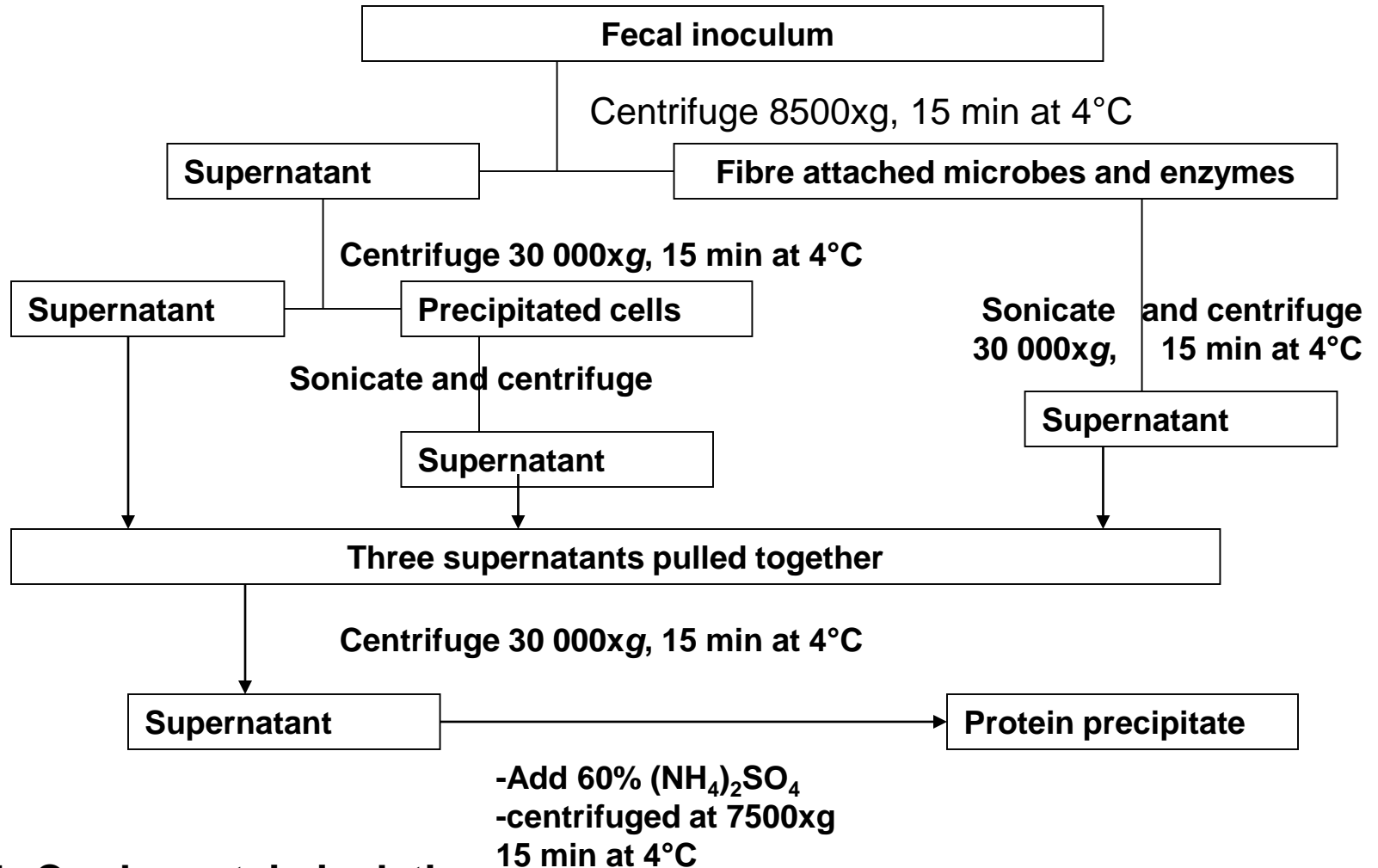
• **Crude protein extraction for cellulase enzyme assays**

| Fecal inoculum |

Centrifuge 8500xg, 15 min at 4°C

| Supernatant | | Fibre attached microbes and enzymes |

**Centrifuge 30 000x$g$, 15 min at 4°C**

| Supernatant | | Precipitated cells |

Sonicate and centrifuge 30 000x$g$, 15 min at 4°C

**Sonicate and centrifuge**

| Supernatant |

| Supernatant |

| Three supernatants pulled together |

**Centrifuge 30 000x$g$, 15 min at 4°C**

| Supernatant | | Protein precipitate |

-Add 60% $(NH_4)_2SO_4$
-centrifuged at 7500xg
15 min at 4°C

**Figure 1: Crude protein isolation**

15

# Material and Methods …

- **Crude protein dialysed using Na-acetate buffer and precipitated using PEG 20000**

- **Protein concentration measured as described by Bradford.[6]**

- **pH activity optimised using carboxymethyl cellulose as substrate[7]**

# Material and Methods …

- **Enzyme assay**

  **-Exocellulase-substrate crystalline cellulose**

  **\*\*Specific activity (µg glucose/mg crude protein) (10% tannin, condensed tannin)**

  **-Endocellulase- substrate carboxymethyl cellulose**

  **-Xylanase-substrate xylan**

  **\*Specific activity (µg xylose/mg crude protein)**

# Material and Methods …

•*In vitro* digestibility using cultured inoculum (Tilley and Terry ,1963)

➢ **1 g** *acacia sieberiana* **+ 67 ml salivary buffer + 33 ml cultured fecal inoculum (condensed tannin made up to 10%)**

➢ **Incubated for 72 h at 39°C (anaerobic environment)**

# In vitro Digestibility

- ➤ Apparent degradability (APD),

- ➤ True degradability (TD),

- ➤ neutral detergent  fibre (NDFD),

- ➤ Cellulose (CD)

- ➤ Acid detergent (ADD),

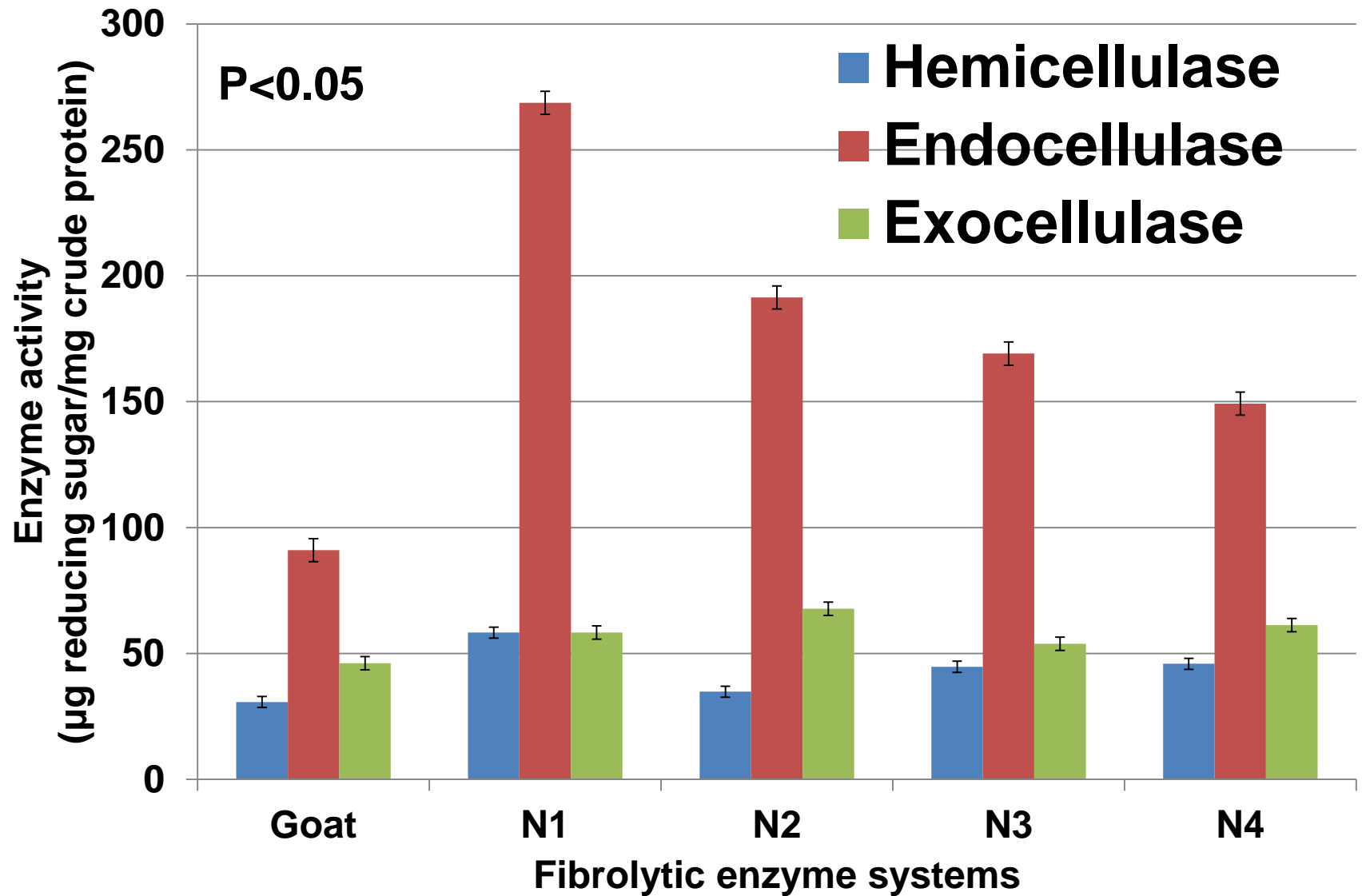- ➤ Hemicellulose (HD)

**Material and Methods …**

➢ **Statistical Analysis**

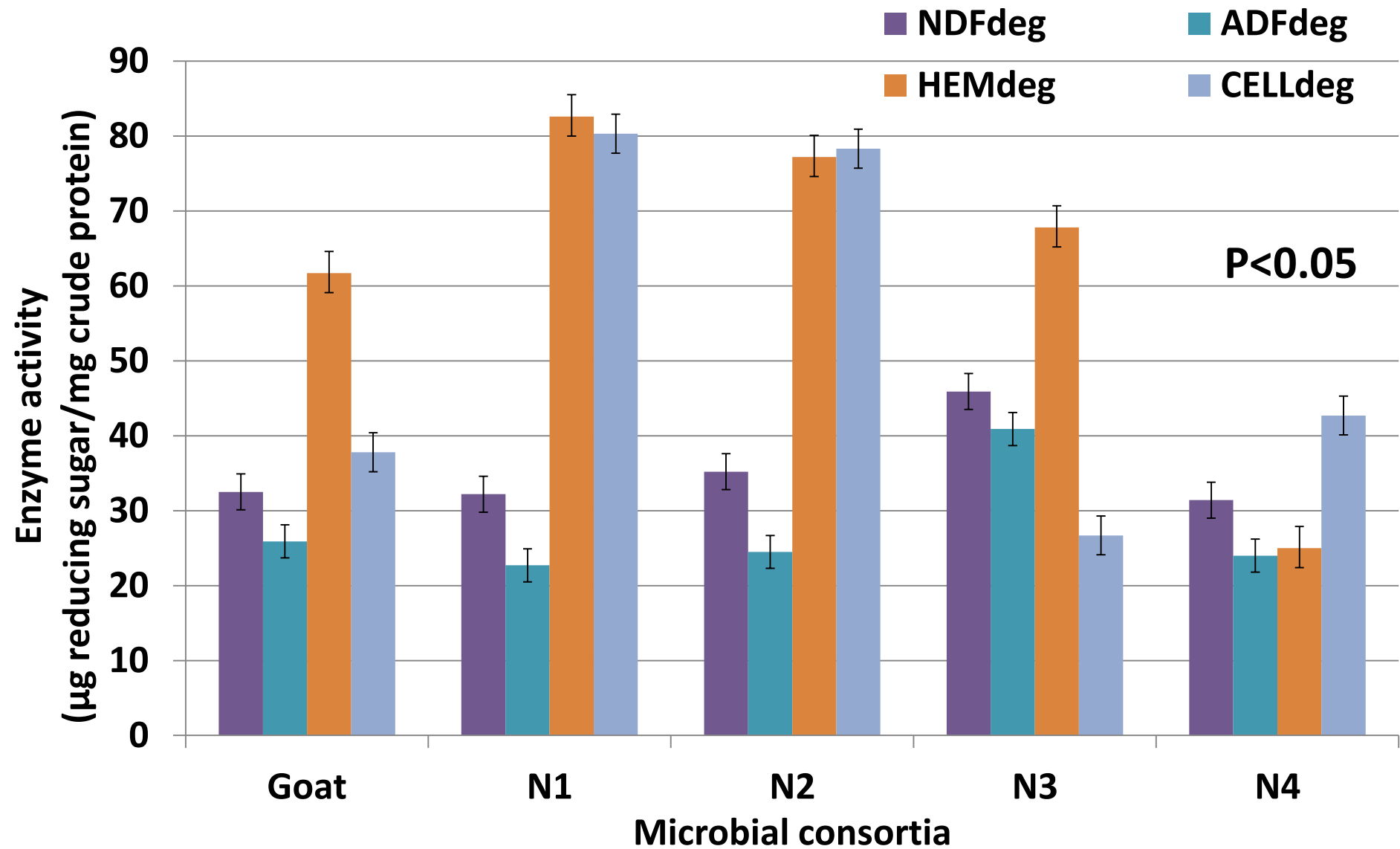•**General linear model of SAS**

- $Y_{ij} = \mu + E_i + \; + e_{ij}$

**Where Y is the individual observation, μ is the overall mean, E is the effect of the inoculum source and e is the random variation.**
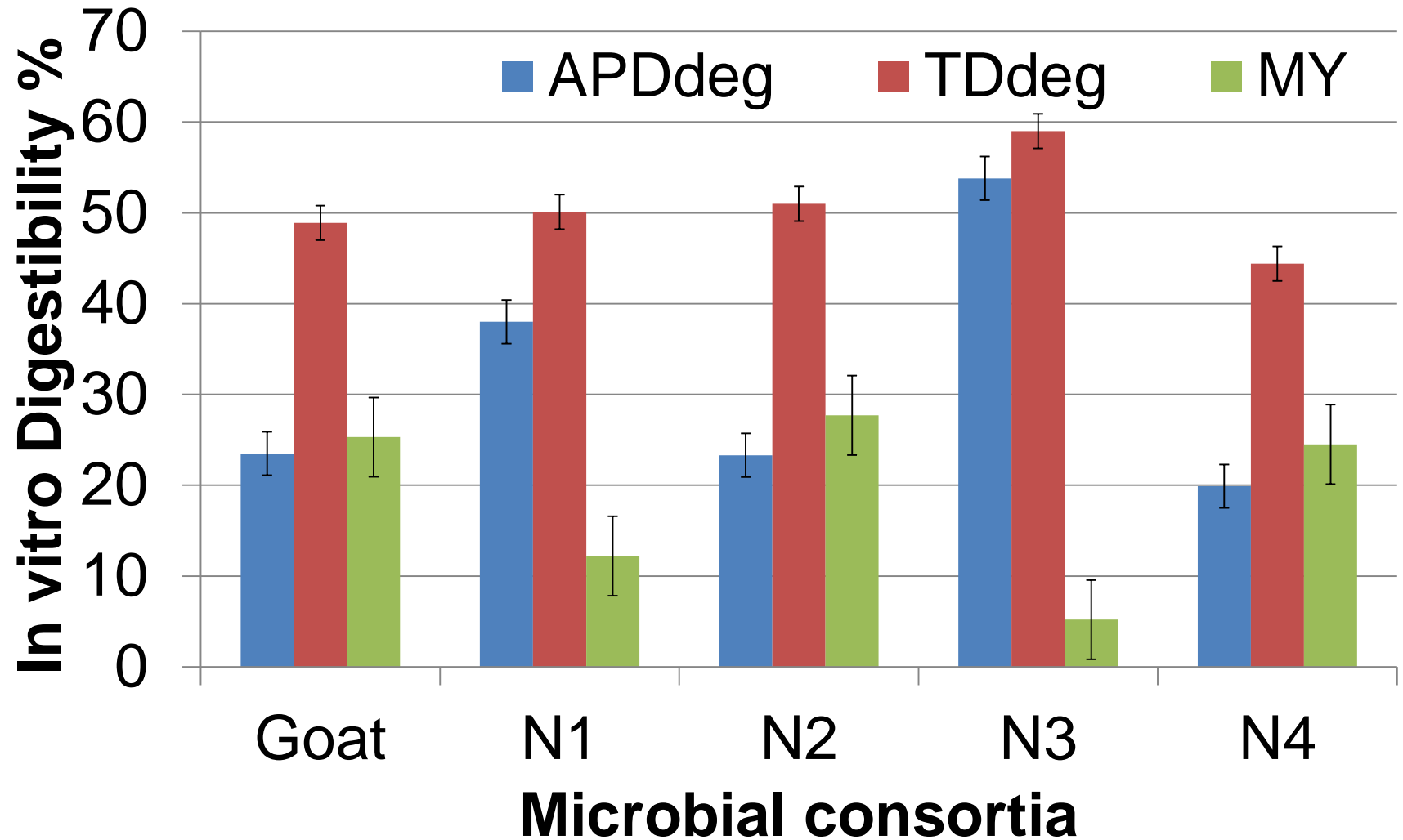
# Results

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# **Conclusion**

- Generally enzymes and microbes from wild animals show a potential to increase nutrient harvest in goat system

- Soluble component of cellulose = higher potential in the presence of relatively higher tannin

- Non-soluble (crystalline) = lower potential though >N3

- Enzyme seems more reliable than microbes

- Further research = complexity inhibition/inhibitors secreted

# Thank You

# Sheep Breeds in South Africa

| | | |
|---|---|---|
| Africana | Istrian | Ille de france |
| Afrino | Karakul | Persian |
| Damara | Leicester | Romanov |
| D ormer | Lincolin | South down |
| Dorper | Meatmaster | Suffolk |
| Dorset | Merino | Van rooy |
| Friesian | Nguni | White dorper |
| Hampshire | Pedi | |

# Goat breeds

Alpine                    Saneen

Angora                    Toggenburg

Boer Goat                 Kalahari red

Gono altai                  Nguni goat