

# Effect of feeding prickly pear by-products silage on dairy ewe's performance



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# INTRODUCTION



- Prickly pear silage, offering a sustainable and nutrient-rich alternative feed source for dairy ewes
- High water content helps in hydration, especially in arid regions
- Rich in fiber and energy, supporting milk production
- Utilizes by-products from prickly pear processing, reducing agricultural waste
- Supports sustainable farming practices, reducing reliance on traditional feed resources



**PPP**  
**(Peels)**

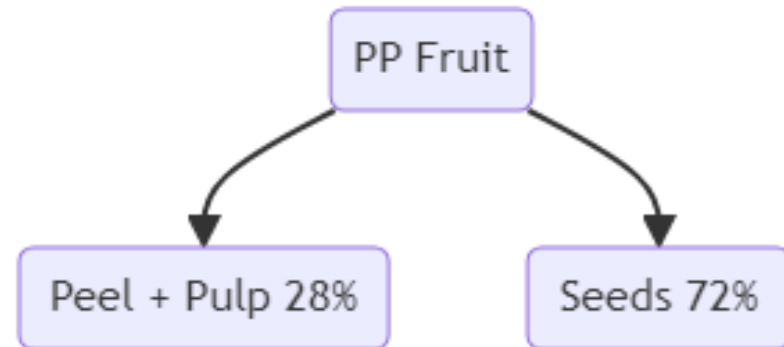


**PPS**  
**(Peels+Pulp+Seeds)**

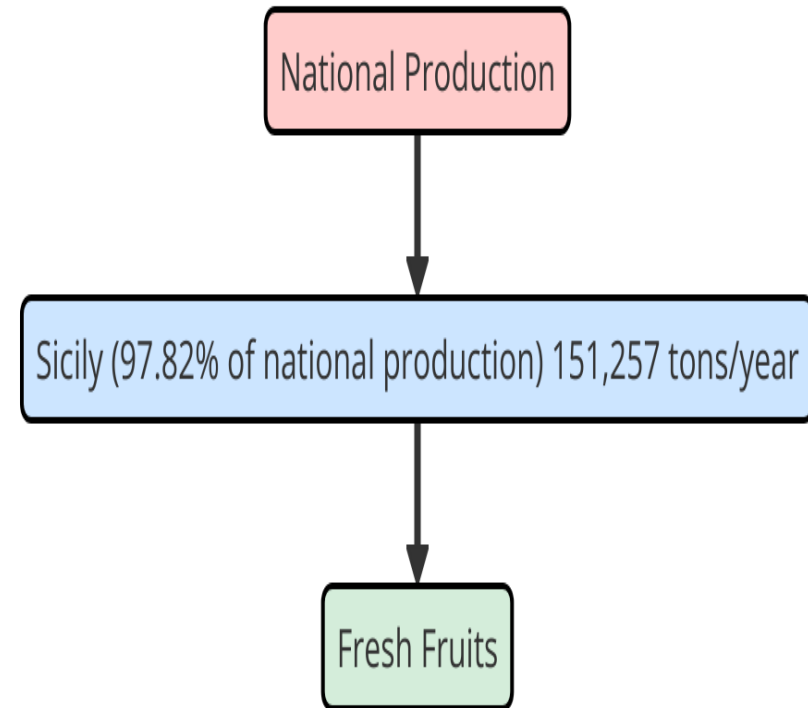


# INTRODUCTION

- ✓ **Mexico**
- ✓ **United states**
- ✓ **Italy (3rd largest Producer)**

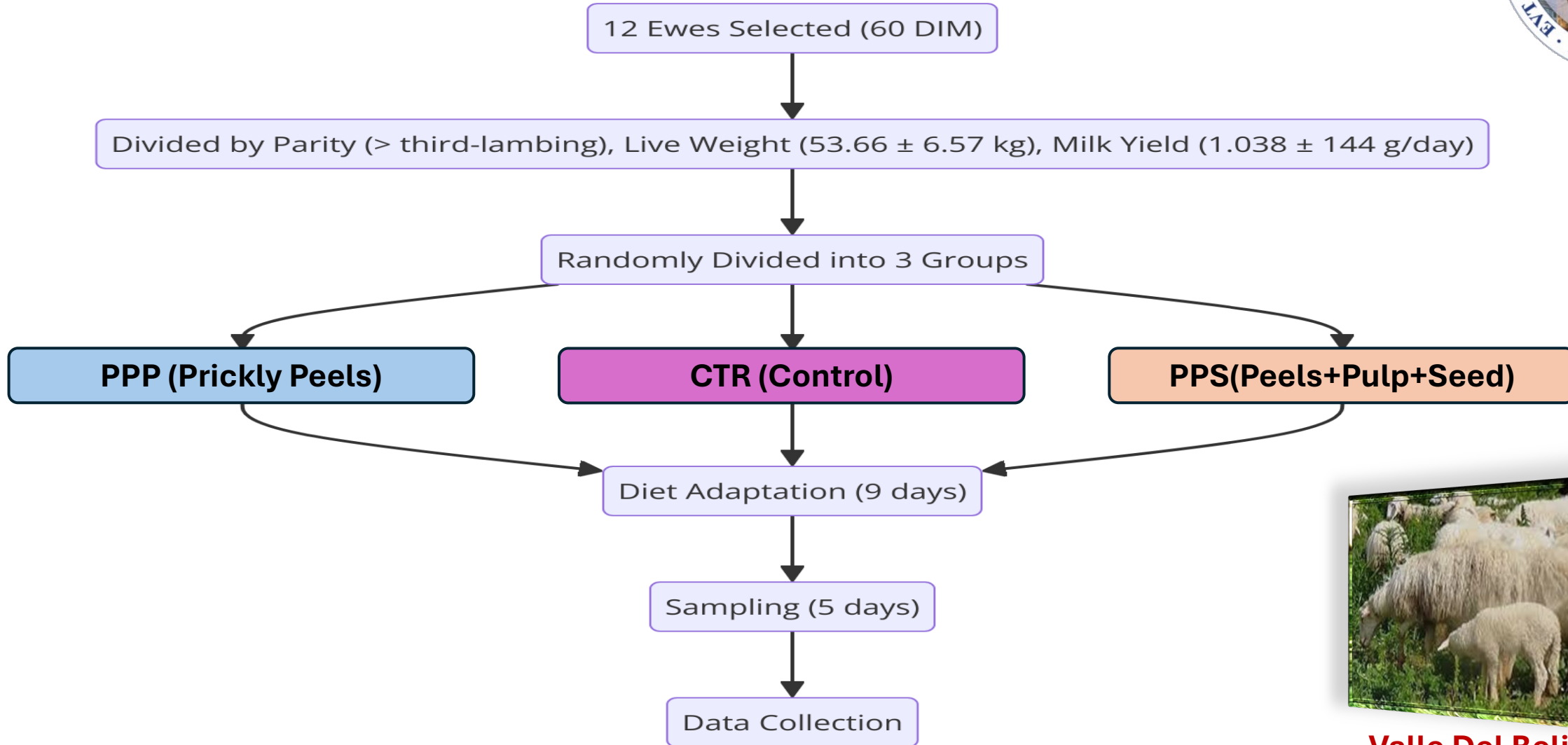


(Todaro et al., 2020)



(ISTAT [2022](#))

# EXPERIMENTAL DESIGN



**Valle Del Belice**



**Estimation of pH**



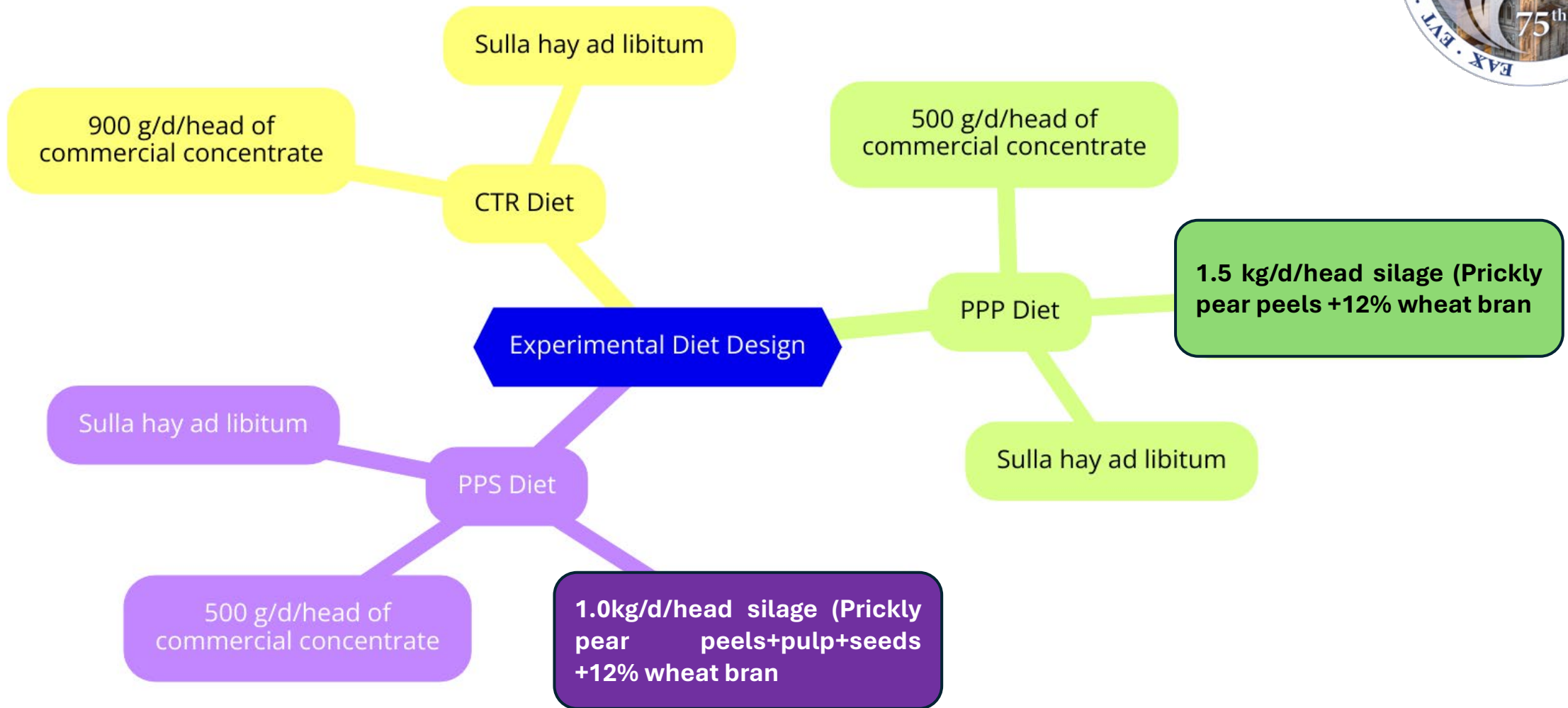
**Prickly Pear Fields**



**Raw material mixing**

**Ewe Pens**

# EXPERIMENTAL DIET



# RESULTS



Chemical composition of feeds (% DM)

| Items          | Raw materials       |                    |                     | Silage             |                     | SEM   | P-value |
|----------------|---------------------|--------------------|---------------------|--------------------|---------------------|-------|---------|
|                | Bran                | PPP                | PPS                 | PPP                | PPS                 |       |         |
| Dry matter     | 88.17 <sup>A</sup>  | 14.97 <sup>E</sup> | 38.47 <sup>C</sup>  | 20.03 <sup>D</sup> | 41.37 <sup>B</sup>  | 0.516 | 0.001   |
| Crude protein  | 18.15 <sup>A</sup>  | 5.16 <sup>E</sup>  | 6.65 <sup>D</sup>   | 12.02 <sup>B</sup> | 9.55 <sup>C</sup>   | 0.227 | 0.001   |
| Ether extract  | 4.62 <sup>ACb</sup> | 1.27 <sup>Dd</sup> | 2.98 <sup>CDc</sup> | 6.15 <sup>Aa</sup> | 3.78 <sup>BCc</sup> | 0.457 | 0.001   |
| aNDFom         | 28.69 <sup>C</sup>  | 20.59 <sup>D</sup> | 70.92 <sup>A</sup>  | 26.60 <sup>C</sup> | 65.27 <sup>B</sup>  | 0.910 | 0.001   |
| ADFom          | 11.20 <sup>C</sup>  | 11.53 <sup>C</sup> | 52.23 <sup>A</sup>  | 11.07 <sup>C</sup> | 46.10 <sup>B</sup>  | 0.748 | 0.001   |
| ADL            | 2.20 <sup>B</sup>   | 1.07 <sup>B</sup>  | 25.00 <sup>A</sup>  | 2.05 <sup>B</sup>  | 24.30 <sup>A</sup>  | 0.567 | 0.001   |
| NFC            | 43.00 <sup>B</sup>  | 60.55 <sup>A</sup> | 10.75 <sup>C</sup>  | 43.71 <sup>B</sup> | 13.31 <sup>C</sup>  | 1.050 | 0.001   |
| WSC            | 4.16 <sup>B</sup>   | 18.60 <sup>A</sup> | 1.50 <sup>B</sup>   | 3.36 <sup>B</sup>  | 1.10 <sup>B</sup>   | 1.051 | 0.001   |
| Ash            | 5.53 <sup>C</sup>   | 11.52 <sup>A</sup> | 8.08 <sup>B</sup>   | 12.43 <sup>A</sup> | 8.70 <sup>B</sup>   | 0.354 | 0.001   |
| pH             | 5.07 <sup>B</sup>   | 5.71 <sup>A</sup>  | 4.15 <sup>C</sup>   | 3.75 <sup>C</sup>  | 4.04 <sup>C</sup>   | 0.144 | 0.001   |
| Activity water | 0.66 <sup>C</sup>   | 0.97 <sup>A</sup>  | 0.97 <sup>A</sup>   | 0.96 <sup>AB</sup> | 0.95 <sup>B</sup>   | 0.005 | 0.001   |

Values with different superscript letters are significant A, B, C, D, E: P ≤0.01; a, b, c, d, e: P ≤0.05



*In vivo* performance of dairy ewes and intake

| Items                        | Diet                     |                         |                          | SEM   | P-value |
|------------------------------|--------------------------|-------------------------|--------------------------|-------|---------|
|                              | CTR                      | PPP                     | PPS                      |       |         |
| Body weight (BW)             | 52.33                    | 53.17                   | 53.54                    | 1.411 | 0.826   |
| <b>Δ BW</b>                  | <b>-0.99<sup>b</sup></b> | +0.08 <sup>ab</sup>     | <b>+0.43<sup>a</sup></b> | 0.423 | 0.051   |
| Body condition score (BCS)   | 3.67                     | 3.79                    | 3.81                     | 0.105 | 0.575   |
| Δ BCS                        | +0.104                   | +0.313                  | +0.125                   | 0.083 | 0.167   |
| <i>Intake (kg DM/d/head)</i> |                          |                         |                          |       |         |
| Hay                          | 1.67 <sup>a</sup>        | <b>1.44<sup>b</sup></b> | 1.58 <sup>ab</sup>       | 0.064 | 0.046   |
| Silage                       | -                        | <b>0.31<sup>B</sup></b> | 0.41 <sup>A</sup>        | 0.003 | 0.001   |
| Concentrate                  | 0.79 <sup>A</sup>        | <b>0.44<sup>B</sup></b> | 0.44 <sup>B</sup>        | 0.001 | 0.001   |
| Total intake                 | <b>2.46<sup>A</sup></b>  | <b>2.18<sup>B</sup></b> | <b>2.44<sup>A</sup></b>  | 0.064 | 0.008   |



## Milk yield and composition of dairy ewes

| Items                    | Diet               |                    |                     | SEM   | P-value |
|--------------------------|--------------------|--------------------|---------------------|-------|---------|
|                          | CTR                | PPP                | PPS                 |       |         |
| Daily milk yield (kg/d)  | 0.80 <sup>a</sup>  | 0.66 <sup>b</sup>  | 0.68 <sup>b</sup>   | 0.038 | 0.030   |
| FPCM (kg/d)*             | 0.86               | 0.75               | 0.77                | 0.043 | 0.179   |
| Fat (%)                  | 7.38               | 8.09               | 7.88                | 0.313 | 0.276   |
| Protein (%)              | 5.86               | 6.29               | 6.04                | 0.128 | 0.074   |
| Casein (%)               | 4.47 <sup>b</sup>  | 4.89 <sup>a</sup>  | 4.65 <sup>ab</sup>  | 0.114 | 0.051   |
| Urea (mg/dl)             | 48.8 <sup>Aa</sup> | 38.4 <sup>Bb</sup> | 40.7 <sup>ABb</sup> | 2.556 | 0.019   |
| Lactose (%)              | 4.30               | 4.15               | 4.23                | 0.114 | 0.681   |
| Somatic cell count (Log) | 2.10               | 2.28               | 2.19                | 0.119 | 0.549   |

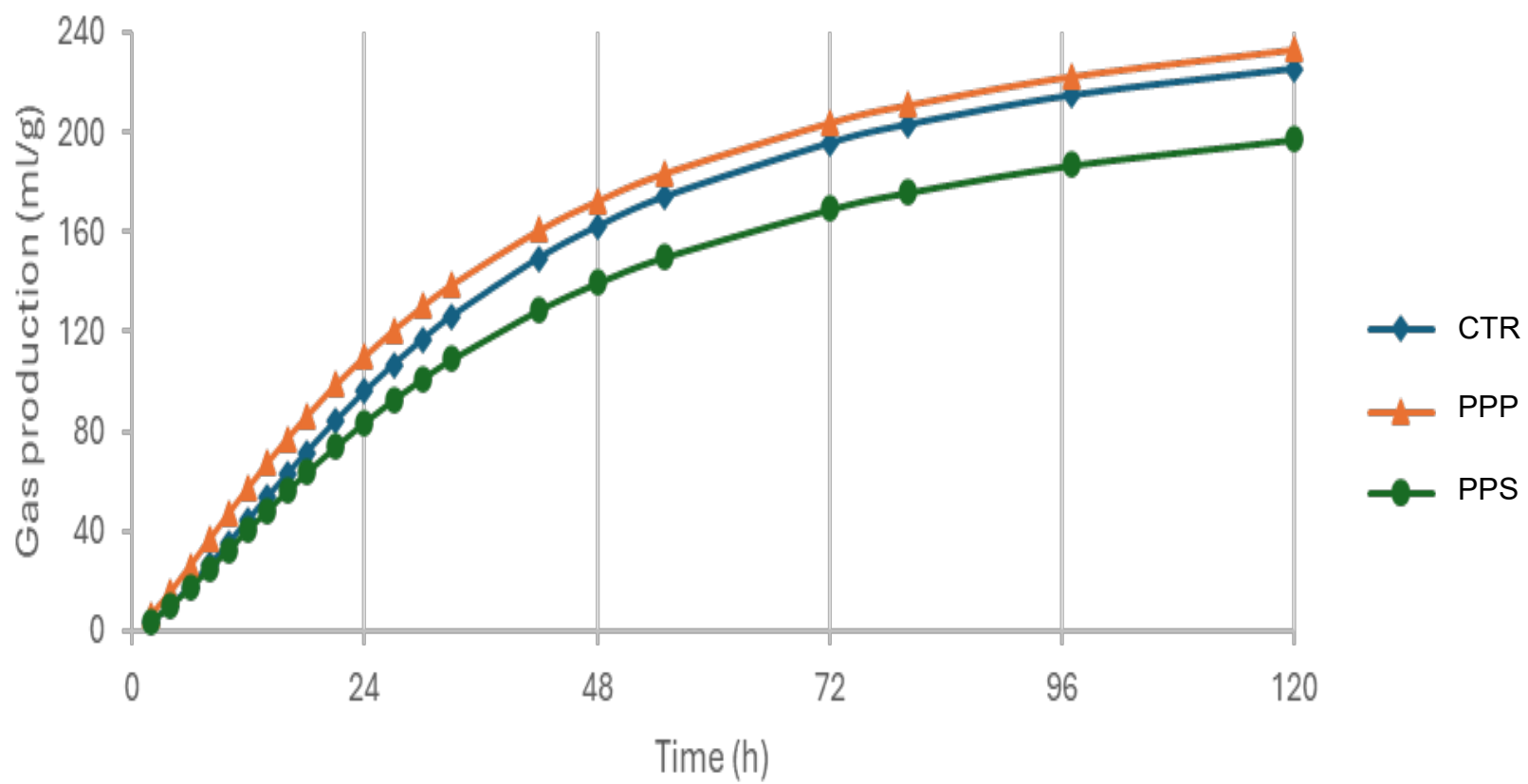
\*Fat and Protein Corrected Milk (FPCM; 6.5% fat; 5.8% protein): Pulina et al., 2005



### Volatile fatty acids (VFAs: mmol/g iOM) and *in vitro* digestibility parameters

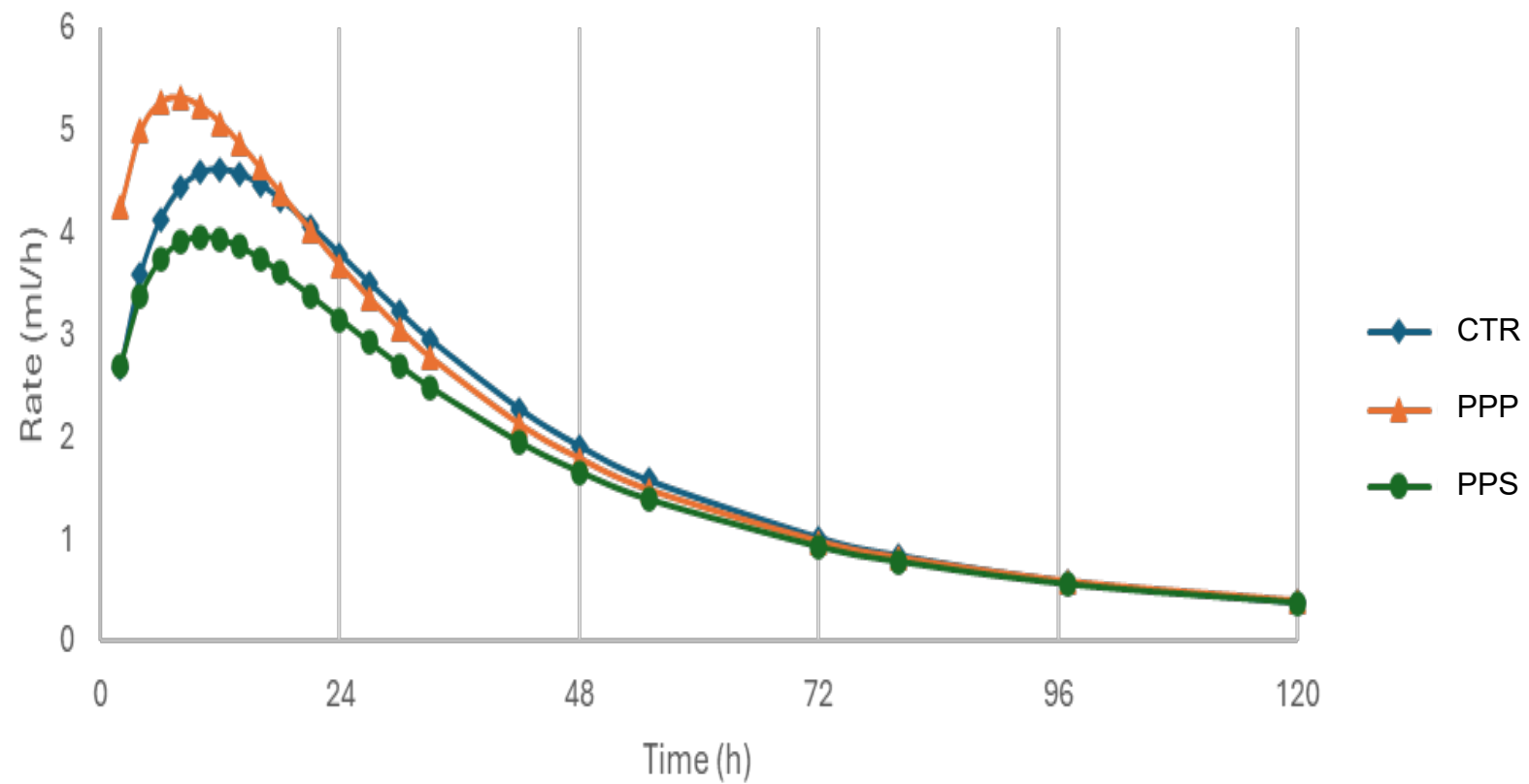
| Parameters         | CTR                | PPP                      | PPS               | SEM   |
|--------------------|--------------------|--------------------------|-------------------|-------|
| pH                 | 6.40 <sup>b</sup>  | 6.41 <sup>ab</sup>       | 6.45 <sup>a</sup> | 0.018 |
| Acetate            | 34.8 <sup>B</sup>  | <b>41.7<sup>A</sup></b>  | 34.1 <sup>B</sup> | 0.56  |
| Propionate         | 12.4 <sup>B</sup>  | <b>14.0<sup>A</sup></b>  | 12.7 <sup>B</sup> | 0.37  |
| Butyrate           | 6.53 <sup>B</sup>  | <b>9.98<sup>A</sup></b>  | 6.74 <sup>B</sup> | 0.40  |
| VFA                | 57.5 <sup>B</sup>  | <b>69.0<sup>A</sup></b>  | 58.8 <sup>B</sup> | 0.97  |
| BCFA (%VFA)        | 5.16               | 5.14                     | 5.28              | 0.21  |
| Acetate/Propionate | 3.34 <sup>AB</sup> | <b>3.54<sup>A</sup></b>  | 3.19 <sup>B</sup> | 0.72  |
| OMD (%)            | 64.8 <sup>A</sup>  | <b>67.4<sup>A</sup></b>  | 52.8 <sup>B</sup> | 1.47  |
| NDFD (%NDF)        | 70.5 <sup>AB</sup> | <b>76.08<sup>A</sup></b> | 62.5 <sup>B</sup> | 3.32  |
| OMCV (ml/g)        | 218 <sup>B</sup>   | 229 <sup>A</sup>         | 196 <sup>C</sup>  | 2.90  |

CTR: control diet; PPP: prickly pear peels; PPS: prickly pear peels+pulp+seeds diet; VFA: volatile fatty acids; BCFA: branched chain fatty acids; iOM: incubated organic matter. Capital and lowercase letter indicate  $p < 0.05$  and  $0.01$  respectively.



**Gas production rate**





***In vitro* fermentation rate**



## Conclusion

- **Supplementation of wheat bran to prickly pear by-products increased the DM% and protein in silage**
- **Higher WSC contents in prickly pear peels (PPP) improves the fermentation process by achieving pH <4**
- **PPP depicted higher total VFA, A/P ratio and OMD than PPS, probably due to the absence of seeds**
- **Improved ruminal fermentation that ↑milk casein and ↓milk urea without any adverse effects on FPCM**

### **TAKE HOME**

- **Lowers the carbon footprint associated with feed production and transportation**
- **Cost effective and environmentally friendly production**





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