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PROTEIN FROM FRACTIONATED FORAGE LEGUMES AS FEED MONOGASTRIC ANIMALS

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Introduction:

- Supply of feed protein is critical for animal production
- The area of pulses has declined in Europe
- Forage legumes can have higher protein yields than pulses



Introduction:

Fractionation into **protein-rich feed** for monogastric animals and **fibre-rich feed** for ruminants can be achieved through e.g. harvesting with a **leaf stripper**, resulting in **leaf and stem fractions** (Julier & Huyghe, 1997) or juicing in **a screw press**, resulting in juice and pulp fractions (Houseman & Jones, 1978).



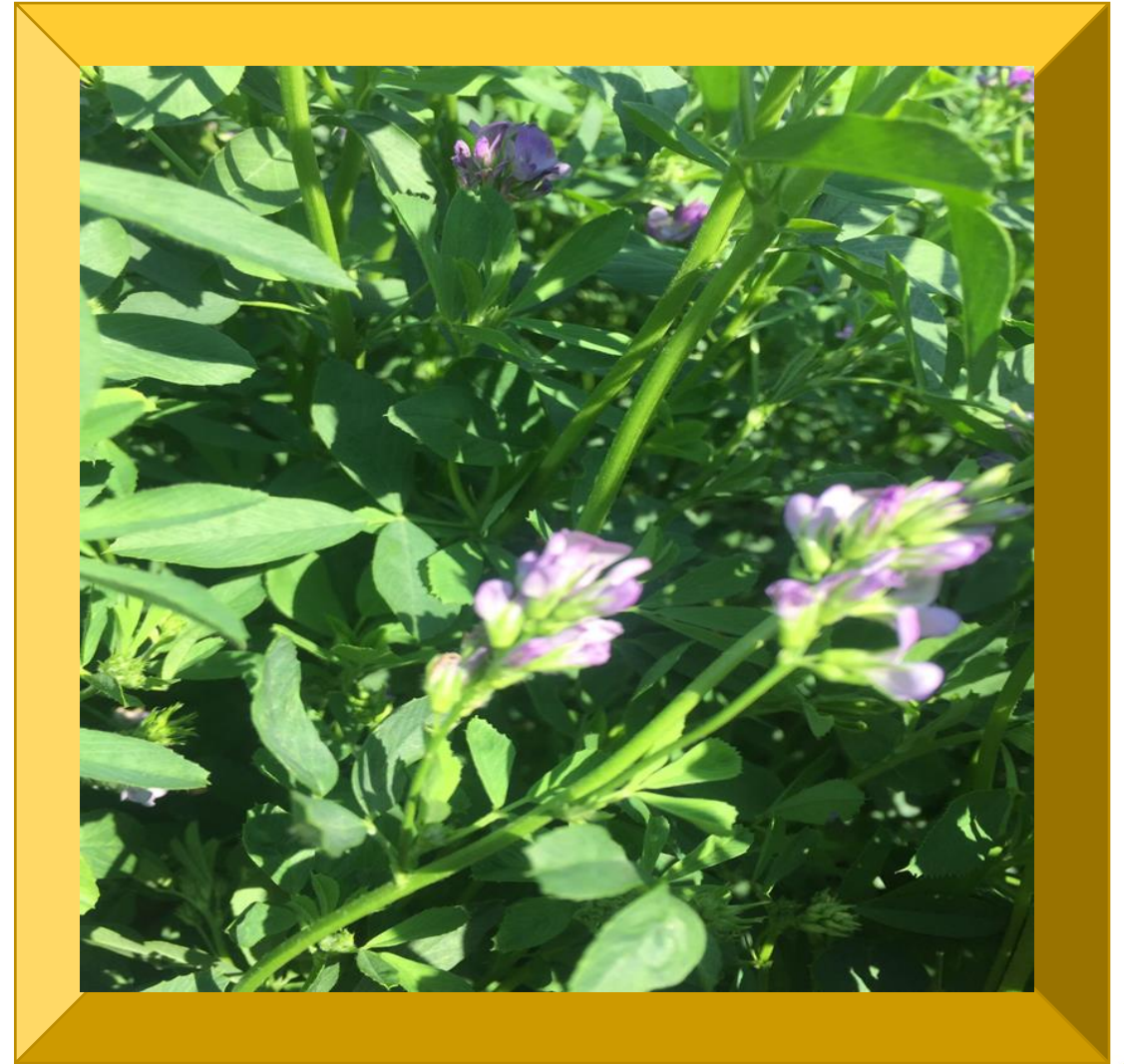
Introduction:

Fractionation of forage legumes unlocks new opportunities, These new systems have potential to be more **self-sufficient and sustainable in organic farming**. The aim of the current study was to assess the effect of fractionation method in **lucerne (*Medicago sativa*)** on protein yield in low-fibre fractions.



Material and methods:

- A field experiment with two **varieties** of lucerne (**Kalender** and **Özpinar**)
- Established in October 2018 in Menemen, in the **Aegean Region** in **Turkey**.
- The Aegean Region has a typical **Mediterranean climate** with hot and dry summer, and mild and rainy winter. The experimental site had an **alluvial soil with clay loam texture**.



Material and methods:

- The varieties were harvested individually when 10% of the plants were at flowering stage.
- The first cut of Kalendar and Özpınar on 17 April and 2 May 2019 harvested respectively.



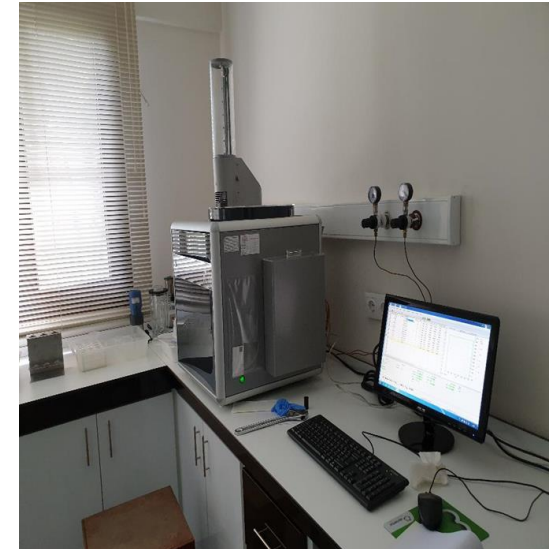
Material and methods:

whole plant samples (500 g) from each plot → fractionated in a screw press (Angel 7500) and yields of juice and pulp were measured.

Mechanical leaf stripping was **carried out manually** and the yields of leaves and stems were measured. A **leaf sample (250 g)** was screw pressed. The samples were analyzed. (Elementer Variomax Cube CN, DUMAS).



(Angel 7500)



(Elementer Variomax
Cube CN, DUMAS).

Material and methods:

- Whole plant, leaf and stem samples were dried in an oven at **65°C**.
- Dry matter content was determined by drying the pre-dried samples at **105°C**.
- Necessary analyses and calculations were completed to find carbon and crude protein content and proportions of crude protein found in the fractions. Crude protein was calculated as nitrogen concentration multiplied with 6.25



Tablo 1. Yields of whole plant and fractions, and concentrations of carbon and crude protein in whole plant and fractions of two lucerne varieties harvested at first cut in Menemen, Turkey

| Item | n | Lucerne, cv. Kalender | | Lucerne, cv. Özpınar | |
|--|---|-----------------------|-----------------|----------------------|-------|
| | | Mean | SD ¹ | Mean | SD |
| Harvesting date | | 17 April | | 2 May | |
| Yield whole crop, kg of DM/ha ² | 6 | 3127 | 484.4 | 2707 | 289.5 |
| Proportion of fractions, g/kg of DM ³ | | | | | |
| Whole crop harvesting | | | | | |
| Juice | 3 | 479 | 68.7 | 377 | 62.5 |
| Pulp | 3 | 521 | 68.7 | 623 | 62.5 |
| Leaf stripping | | | | | |
| Leaves | 3 | 469 | 57.6 | 597 | 52.1 |
| Stems | 3 | 531 | 57.6 | 403 | 52.1 |
| Pressing of leaves | | | | | |
| Leaf juice | 3 | 536 | 99.0 | 393 | 49.7 |
| Leaf pulp | 3 | 464 | 99.0 | 607 | 49.7 |
| Leaf juice of total yield | 3 | 254 | 73.3 | 236 | 48.8 |
| Leaf pulp of total yield | 3 | 215 | 35.2 | 361 | 15.4 |
| Carbon content, g/kg of DM | | | | | |
| Whole crop | 6 | 453 | 6.7 | 439 | 3.3 |
| Juice | 3 | 336 | 50.7 | 383 | 10.1 |
| Pulp | 3 | 527 | 61.7 | 510 | 87.6 |
| Leaves | 3 | 452 | 3.9 | 431 | 3.9 |
| Stems | 3 | 448 | 1.3 | 444 | 5.2 |
| Leaf juice | 3 | 376 | 72.9 | 373 | 5.4 |
| Leaf pulp | 3 | 477 | 12.9 | 453 | 30.8 |

| Crude protein content, g/kg of DM | | | | | |
|--|---|-----|-------|-----|------|
| Whole crop | 6 | 196 | 12.5 | 171 | 10.6 |
| Juice | 3 | 226 | 41.1 | 226 | 4.5 |
| Pulp | 3 | 138 | 23.7 | 127 | 19.4 |
| Leaves | 3 | 268 | 4.5 | 223 | 14.8 |
| Stems | 3 | 118 | 5.6 | 100 | 3.0 |
| Leaf juice | 3 | 266 | 51.9 | 245 | 21.0 |
| Leaf pulp | 3 | 197 | 9.6 | 184 | 18.0 |
| Crude protein yield of whole crop, kg/ha | 6 | 610 | 83.0 | 462 | 46.6 |
| Proportion of crude protein found in fractions on DM basis | | | | | |
| Juice | 3 | 600 | 17.8 | 519 | 38.4 |
| Pulp | 3 | 400 | 17.8 | 481 | 38.4 |
| Leaves | 3 | 656 | 85.4 | 754 | 83.7 |
| Stems | 3 | 327 | 23.1 | 228 | 26.8 |
| Leaf juice | 3 | 353 | 132.2 | 328 | 77.4 |
| Leaf pulp | 3 | 221 | 30.7 | 376 | 40.1 |

¹ SD = standard deviation.

² DM = dry matter.

³ Losses during fractionation were excluded.

Results and discussion:

- **Kalender** reached the stage of **early** flowering **15 days** earlier **than Özpınar**
- At harvesting **Kalender** was 45.2 cm high and **Özpınar** 47.0 cm
- **Kalender** had a dry matter yield of 3,127 kg/ha and **Özpınar** 2,707 kg/ha (Table 1).
- Weeds accounted for 2% of the fresh crop at first cut.
- On average, **43% of the dry matter** was found in the **juice fraction** after pressing whole plant samples.
- **Kalender** yielded **more juice** than **Özpınar**. **Leaf fraction** the juice yield was **slightly higher** The **leaf yields** (avr. 53%) were higher than the juice yields and they were higher **for Özpınar** than for **Kalender**.
- The **carbon content** of the **whole plant**: average **45%**. Juice contained less carbon than pulp, but there were only small differences between leaf and stem fractions.

Results and discussion:

- The carbon content in juice from whole plant was similar to that of leaves
- Carbon content in pulp from leaves was lower than that of whole plant
- **Whole plant** samples of **Kalender had 19.6% crude protein** and **Özpinar 17.1%**
- **In juice** there were **no differences** between the **varieties** (22.6% crude protein on dry matter basis)
- **Leaf juice had high** content of **crude protein** than **juice from whole plants** (on average **25.5%**).

Results and discussion:

- The **crude protein** content of **leaves** was **24.6%** on average
- In leaves and leaf juice, **Kalender** had higher crude protein content than **Özpinar**
The fibre-rich fractions had reduced content of crude protein
- **Whole plant pulp 13.3%** and **leaf pulp 19.1%** had still considerable content of crude protein
- **Stems** had only **10.9%** of crude protein
- The proportion of the crude protein from the **whole plant** yields found in **leaves 70%** was higher than in the **juice 55%**
- This together with easier mechanisation is an argument to apply **leaf stripping** instead of **juice pressing** when producing **protein rich feeds for monogastrics**.

Results and discussion:

Further research is necessary to assess

- Protein quality
- Amino acid composition
- Digestibility of the different fractions
- Need further investigation
- The effects of variety
- Harvesting time
- Number of cut

- **When separating forage crops into different fractions it is important to find useful applications for all fractions.**





This work is part of the **CORE Organic Cofund project ProRefine** (Refined forage legumes as local sources of protein feed for monogastrics and high quality fibre feed for ruminants in organic production).





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Thank you!

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