



Nutrient-dense livestock feed pellets manufactured in Tunisia can compete with imported feed concentrates

Photo: ICARDA/Udo Rufinger

KEY MESSAGES

- Agro-industrial by-products, which would otherwise be waste, can become valuable in the livestock feed sector.
- A livestock feed pellet manufacturing unit can enable farmers to alter their livestock feed formulas according to the needs of their animals.
- Access to subsidized feed ingredients, such as barley and wheat bran, is necessary for the locally produced pellets to compete with costly imported feed concentrates.

Photo caption: Pellets produced are given as a nutritious feed to livestock.

SUMMARY

Producing animal feed pellets from agro-industrial by-products is a simple and cost-effective way to transform what would otherwise be considered waste into quality, nutritional feed.

TURNING WASTE INTO NUTRITIOUS ANIMAL FEED

Researchers from the International Centre for Agricultural Research in the Dry Areas (ICARDA), together with livestock implementing partners in Tunisia, set out to locally manufacture feed pellets that would be of value to livestock farmers and that would use agro-industrial by-products. Olive cakes and cactus peels are examples of valuable feed ingredients that would otherwise be discarded but have proven to serve as valuable, locally available, cost-effective inputs for farmers to feed their livestock.

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The initiative to manufacture feed pellets stemmed from an original idea of producing feed blocks. A feed block manufacturing unit was developed in collaboration with a Tunisian metal manufacturer and aimed to encourage private enterprises and cooperatives to produce and sell the feed blocks to smallholder livestock farmers. The unit, which could produce up to five tons of feed blocks per day, was tested on various enterprises, including an apple farmer cooperative that wanted to add value to overripe apples, which would otherwise have been discarded.

Over three years, many lessons were learnt. The idea was improved and transformed into the production of feed pellets, a nutritious supplementary feed competing with expensive imported concentrates, proving to be valuable for various farming sectors in Tunisia.

Feed pellets, made from agro-industrial by-products, are thoroughly dried and are highly resistant to rotting. In addition, they are small and can be rationed accurately. The bags are easy to manage and store, and can withstand rough handling during loading and transport, which minimizes waste.

An important consideration in this initiative is that locally produced pellets would compete with imported lucerne or concentrate pellets in terms of nutrient density and cost. Therefore, various pellet feed compositions were tested.



Goats eating feed blocks. Photo ICARDA/Udo Rudiger

Table 1. Pellet feed composition of four different formulas.

| | Formula 1 (%) | Formula 2 (%) | Formula 3 (%) | Formula 4 (%) |
|---------------------|---------------|---------------|---------------|---------------|
| Olive cake | 34 | 45 | - | - |
| Wheat bran | 32 | 36 | 30 | 30 |
| Ground barley | - | - | 15 | 15 |
| Faba beans | 30 | - | - | - |
| Soy cake | - | 15 | - | - |
| Lucerne | - | - | 9 | 9 |
| Ground date kernels | - | - | 40 | - |
| Downgraded dates | - | - | - | 40 |
| CMV (minerals) | 4 | 4 | 6 | 6 |



Small pelleting machines. Photo ICARDA/Udo Rudiger



Feed pellets, made from a range of agro-industrial raw materials, are thoroughly dried and are resistant to rotting. Photo ICARDA/Udo Rudiger

Table 2. Nutritional value and costs of four pellet formulas compared to imported concentrates and lucerne pellets.

| | Formula 1 (%) | Formula 2 (%) | Formula 3 (%) | Formula 4 (%) | Lucerne pellets (%) | Concentrate pellets (%) |
|------------------|---------------|---------------|---------------|---------------|---------------------|-------------------------|
| Dry matter | 75.3 | 71.3 | 87.3 | 90.2 | 93.2 | 91.1 |
| Crude protein | 17.6 | 17.6 | 8.9 | 8.4 | 14.3 | 15.4 |
| Crude cellulose | 14.1 | 18.6 | 9.8 | 8.6 | 28.5 | 4.9 |
| Fat | 3.9 | 6.0 | 3.8 | 2.0 | - | 5.2 |
| Ash | 10.6 | 10.6 | 10.1 | 9.9 | 9.9 | 9.4 |
| Phosphorus | 0.6 | 0.6 | 0.4 | 0.3 | - | 0.5 |
| Calcium | 1.4 | 1.3 | 1.1 | 0.3 | - | 1.8 |
| Costs (US\$/ton) | 195 | 180 | NA | NA | 255 | 206 |

Formula 1 and formula 2, which have been formulated with faba beans or soy cakes as the source of protein, not only have a higher protein content than imported pellets, but they are less expensive. Formula 3 and 4 are suitable for livestock farmers in

South Tunisia, where there are abundant dates. Date kernels and substandard dates can be valuable by using them to produce pellets. However, both these two formulas would need to be improved to increase protein content.

CASE STUDY: saving costs and improving quality

Abdellah Jajili is a livestock farmer in El Fahs, in central Tunisia, who owns 350 small ruminants and 35 cattle. He produces his own feed pellets from locally available material. He prefers the pellets because they are nearly half the price of feed concentrates from the shops and they are fresher than imported feed, which are sometimes old and rotten.

Abdellah started out with a small pelleting machine with a capacity of 100 kg/hour then later purchased a larger one with a capacity of 500 kg/hour.

The machines are produced in China and distributed by an importer who also provides spare parts and servicing.

Table 3. Pellet ingredients per animal species used by Abdellah.

| | Barley grains | Soybean or faba beans | Maize | Wheat bran | Olive cake | Minerals and vitamins |
|----------------|---------------|-----------------------|-------|------------|------------|-----------------------|
| Small ruminant | 60% | 20% | 5% | 13% | 0 | 2% |
| Young cattle | 60% | 10% | 0 | 0 | 28% | 2% |

Abdellah alters the ingredients and formulation of the pellets according to the nutrition needs of his animals. When fattening young sheep more rapidly four months before the Muslim holiday of *Eid*, he uses greater quantities of soybean or faba beans and maize in the pellets, containing 15 - 20% protein. For young cattle grown for red meat, they are fed a combination of pellets containing 13-16% protein and hay and straw.

As an owner of a large stock of ruminants, Abdellah can avail of subsidized barley grains (TND 0.52/kg). He is also a shareholder of an olive oil factory which gives him access to olive cakes, a by-product of olive oil production, at nearly no cost. His investment



A farmer with his pellet machine.
Photo ICARDA/Udo Rudiger

in the pellet machine is therefore enhanced by his access to low-cost feed material.

Abdellah's daily requirement of feed pellets is about 525 kg (350 kg for 350 sheep, plus 175 kg for 35 cows). To produce the weekly pellet requirement of 3.7 tons, he spends two half-days per week using his 500 kg/hour pellet machine (TND 9,000/ USD 3,240).

To develop a large-scale pellet production business, a machine capacity of at least 3 tons per hour would be necessary. Although such a machine exists in China and could be imported to Tunisia, Abdellah says that obtaining a pellet production license from the government is a challenge.

CHALLENGES

For the local production of feed pellets to compete with imported concentrates, farmers would need access to subsidized ingredients and the reliable availability of agro-industrial by-products. For this reason, this feed pellet manufacturing unit would be best suited to farmer cooperatives or large-scale farmers. In addition, ingredients or by-products necessary for feed pellets, like olive cakes and cactus fruit pulp, are typically only available during a certain period of the year, which reduces the production period.

Access to wheat bran and barley grains, important parts of many feed block formulas (20 - 30%), is very difficult for small-scale producers.

Another consideration is access to subsidized feed. Governmental distribution of subsidized wheat bran and barley caters to two groups: livestock farmers who obtain a certain amount of feed based on their number of animals, and large-scale feed producers who must adhere to various regulations that are difficult for small-scale farmers enterprises to fulfil.

CONCLUSION: IMPLICATIONS AND RECOMMENDATIONS

The local production of feed pellets using machines has the potential to compete with expensive imported feed pellet concentrates. This initiative would be best suited to farmer cooperatives and large livestock farmers who have access to subsidized barley and wheat bran and agro-industrial by-products that can be valuable as feed ingredients.

Feed pellets are easy to produce, stock, handle and ration. The pellets reduce feed loss and turn what would otherwise be waste into valuable feed. However, the availability of by-products is essential to produce the pellets.

Wood, J.F. 1987. The functional properties of feed raw materials and their effect on the production and quality of feed pellets, *Animal Feed Science and Technology*, 18(1): 1-17, [https://doi.org/10.1016/0377-8401\(87\)90025-3](https://doi.org/10.1016/0377-8401(87)90025-3)

Rudiger, U. and Werner, J. 2017. Improving Feed for Increasing Smallholders Income (Blog accessed via <https://repo.mel.cgiar.org/handle/20.500.11766/6161>)

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Further reading

Gouhis, F., Moujahed, N., Nefzaoui, A. and Louhaichi. 2017. Feed Blocks: Reduce chronic feed deficits and production costs. *Fact sheet* <https://hdl.handle.net/20.500.11766/8577>

Farahat, M. H. 2015. Good quality feed pellets: Does it make sense? (Blog <https://www.allaboutfeed.net/animal-feed/feed-processing/good-quality-feed-pellets-does-it-make-sense/>)

Vasta V., Nudda, A., Cannas, A., Lanza, M., Priolo, A. 2008. Alternative feed resources and their effects on the quality of meat and milk from small ruminants, *Animal Feed Science and Technology*, 147(1-3): 223-246. <https://doi.org/10.1016/j.anifeedsci.2007.09.020>

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The solution proposed in this brief is part of a basket of solutions that can help livestock producers raise efficiencies and productivity. While there is the opportunity for more research, the feed pelleting business model can be considered a candidate model for scaling and be adapted into an integrated model for sustainable intensification of livestock production for smallholder farmers.