Use of Tallow in Biodiesel

As triglycerides, animal fats can be used for biodiesel production just as easily as plant oils.

However, there are some structural limitations.

Tallow availability

The EU has about 2.5 MT p.a. of tallow available, of which about 1MT are used for industrial purposes. There are estimated to be about 14MT of tallow available globally.

Total availability of tallow is unlikely to increase, particularly in the EU, as the herds of commercial meat animals are not increasing significantly.

Tallow has an existing market in conventional oleochemicals as a unique feedstock with properties that are hard to reproduce from plant oils. However, concerns about BSE may permanently shift the applications of tallow away from those involving close human contact (such as soap and cosmetics) towards industrial applications such as rubber, lubricants and fuel.

The benchmark fatty acid profile is beef tallow. A typical fatty acid composition compared to low erucic rape is:

Fatty acid	Beef tallow	Low erucic rape
C14	2-6%	0-2%
C16	24-37%	1-5%
C16:1	2-4%	
C18	14-29%	0-3%
C18:1	26-50%	50-66%
C18:2	1-5%	18-30%
C18:3	0-2%	6-14%
C20		0-1%
C20:1		0-5%
C22		0-1%
C22:1		0-5%

Beef tallow has very high levels of saturated fatty acids and very low levels of polyunsaturated fatty acids compared to rape.

Biodiesel from tallow

Biodiesel can be easily made from tallow using very similar processes to plant oils. However, it has some advantages and disadvantages that are agreed between different studies.

Advantage:

- Higher cetane number than plant oil biodiesel. This means cleaner and more efficient burning in diesel engines.

Disadvantage:

- Higher cloud point. Because of the high levels of saturates, biodiesel from tallow tends to crystallise out at much higher temperatures than biodiesel from plant oils. In Northern Europe this makes tallow biodiesel unsuitable for winter use apart from blending at low rates into conventional diesel. Tallow diesel cannot meet the required DIN standard for 100% biodiesel, but as a 5% mix with conventional diesel it meets the required standards.

The contentious issue is the life cycle analysis. An analysis has been published by Argent Energy (a main player in tallow diesel) from a study commissioned from the Technical University of Graz that claims that:

> "Regardless of the setting of system boundaries biodiesel from tallow and used vegetable oil performs better than fossil diesel and other sorts of biodiesel. The ecological footprint (SPI) of different sorts of biodiesel rises from -1,2 m²a/MJ combustion energy for biodiesel from used vegetable oil (the negative value signifies the large positive impact of the replacement of fossil glycerol by the by-product of this production) to a value between -1,2 and 2,8 m²a/MJ (depending on the scenario) for tallow methyl ester up to 10,3 m²a/MJ for RME (rapeseed methyl ester) compared to 26,1 m²a/MJ for fossil diesel."

This suggests that biodiesel from tallow has a much lower impact than biodiesel from rapeseed. To reach this conclusion the study assumes that there are no environmental impacts whatever involved in producing the tallow. This is justified by declaring the tallow to be a pure waste stream and allocating all environmental impacts of animal production to the meat products. Further, it assumes that the glycerol produced as co-product substitutes for fossil derived glycerol and claims an additional environmental benefit as a result.

This is bizarre thinking as we already have a world glut of natural glycerol, and synthetic glycerol was only used in certain applications, such as some pharmaceuticals where natural products were not acceptable. Tallow glycerol would never be used in these applications.

The analysis also ignores the fact that tallow is already used industrially for a wide range of applications, and if finite stocks are diverted to biodiesel production, you need to account in the LCA for the petrochemical products that substitute the missing oleochemical products.

General good LCA practice suggests that you allocate the overall environmental impact of production of a multi-use material among the applications of that material, usually by weight. Thus each tonne of aluminium at the factory gate carries a specific environmental burden.
To ignore this procedure in the case of tallow seems capricious, and rather suspicious when it provides such an attractive conclusion to industry promoting the use of tallow for biodiesel.

Other studies have been much more measured in their conclusions, suggesting that using tallow for biodiesel makes sense if there is genuinely no other outlet for the tallow (Government of Ontario study), or that the GHG savings from tallow biodiesel are less than for plant oils because of the additional impacts of animal production. A study published in 2004 by Climate Change Central assembled data from several LCA studies on the use of different feedstocks for biodiesel. These included substitution effects in their analysis, and concluded that the GHG savings are very similar across all feedstocks. Given the data uncertainties we should regard them as the same.

Conclusions

- There are no environmental advantages to using tallow as a biodiesel feedstock instead of plant oils.
- Total availability of tallow as a feedstock is limited and cannot be increased.
- Use of tallow for biodiesel competes with existing commercial outlets where the properties of the specific fatty acid composition brings advantages
    - very low polyunsaturates gives excellent oxidative stability in industrial applications
- Tallow is not the best feedstock for biodiesel – especially for fuel use in areas with cold winters. High cloud is more of a problem than higher cetane number is a benefit.
- Exploitation of tallow will make economic sense for companies like Argent who are vertically integrated into rendering, but it will always be a minor component of the whole biodiesel picture.