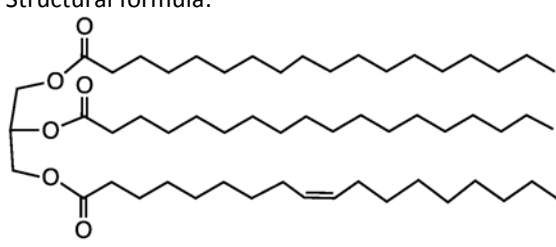


Environmental Fact Sheet (#21)

Beef Tallow

renewable precursor

Substance Identification	
IUPAC Name	Tallow
CAS Number	61789-97-7
Other Names	
Molecular Formula	UVCB Structural formula: 
Physical/Chemical Properties [1]	
Molecular Weight	No data available
Physical state	No data available
Appearance	No data available
Odour	No data available
Density	0.860-0.870 at 15.5-90 °C
Melting Points	No data available
Boiling point	No data available
Flash Point	No data available
Vapour Pressure	No data available
Water Solubility	No data available
Flammability	No data available
Explosive Properties	No data available
Surface Tension	No data available
Octanol/water Partition coefficient (Kow)	No data available
Product and Process Description	<p>The process for producing tallow consists of three-stage:</p> <p>Beef production: this step includes the fodder production, energy requirement at the farms, livestock production and manure management.</p> <p>Abattoir (Slaughterhouse): The live cattle are transported to the abattoir where it is slaughtered. The carcass is further processed to meat for consumption. Along the slaughtering process three co-products were considered: material suitable for rendering, hides, and offals/ bovine blood. Material suitable for rendering (31% of the live animal weight) is transported to the rendering facility where it is further treated.</p> <p>Rendering: involves crushing the raw material, followed by the indirect application of heat. This evaporates the moisture and enables the fat, known as 'tallow', to be separated from the high-protein solids, known as 'greaves'. Pure tallow is a creamy-white substance. The greaves are pressed, centrifuged or subjected to a process of solvent extraction to remove more tallow, before being ground into meat and bone meal (MBM) [4].</p>

	Tallow used as precursor for surfactants usually has a moisture content of max. 1% [5].
Application	The most common applications are as raw materials for soap and fatty acid derivatives, use in animal feed, and a small part of the annually production volume is used as edible fat.

Life Cycle Assessment

General Introduction

These Environmental Fact Sheets are a product of the *ERASM Surfactant Life Cycle & Ecofootprinting (SLE)* project. The objective of this project was to create representative, global, attributional, industry average datasets for tallow based precursors in the production of several particular surfactants.

The fact Sheets are based upon life cycle assessment (LCA) and have been prepared in accordance with the ISO standard [ISO 14040: 2006 and ISO 14044: 2006]. In addition, the project follows the ILCD (2010) handbook. This Fact Sheet describes the cradle-to-gate production for tallow. Tallow is an oleo chemical precursor for the production of surfactants.

Further information on the ERASM SLE project and the source of these datasets can be found in [2].

The full LCI can be accessed via www.erasm.org or via <http://lcdn.thinkstep.com/Node/>

Goal and Scope of ERASM SLE Project [2]

The main goal was to perform a LCI datasets of tallow in the framework of ERASM SLE project in order to provide reliable data on the environmental burdens of production of tallow and tallow fatty acids, which are a major resource in their surfactants production.

Temporal Coverage	Data collected for the production were based on literature research covering one production year. This study used available information including a timeframe of 10 years (2003 – 2012). The used data are believed not to have substantially changed in the last 10 years. Background data dates back to the reference year 2011 for electricity and thermal energy generation, fuel supply, transports, water, waste water treatment. The datasets are considered to be valid until substantial technological changes in the production chain occur. The temporal representativeness for beef tallow was considered 'fair'.
Geographical Coverage	Data of tallow represents the cradle-to gate production of tallow purchased on the EU-27 market. The geographical representativeness for beef tallow was considered 'good'.
Technological Coverage	The production technology was based on different literature sources. The technological representativeness for beef tallow was considered 'fair'. Figure 1 provides a schematic overview of the production process of beef tallow.
Declared Unit	In ERASM SLE project the declared unit (functional unit) and the reference flow of the product is one thousand kilogram (1000 kg). Functional Unit: 1 tonne tallow at processing (rendering) gate.

Cradle-to Gate System Boundaries	<table border="1"> <thead> <tr> <th>Included</th> <th>Excluded</th> </tr> </thead> <tbody> <tr> <td>Beef cattle</td> <td>Equipment</td> </tr> <tr> <td>Transport to abattoir</td> <td>Transport after rendering gate</td> </tr> <tr> <td>Slaughtering</td> <td>Human labour</td> </tr> <tr> <td>Transport to rendering facility</td> <td></td> </tr> <tr> <td>Rendering</td> <td></td> </tr> </tbody> </table>		Included	Excluded	Beef cattle	Equipment	Transport to abattoir	Transport after rendering gate	Slaughtering	Human labour	Transport to rendering facility		Rendering	
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	Beef cattle	Equipment												
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	Slaughtering	Human labour												
	Transport to rendering facility													
Rendering														
Assumptions and Limitations	This study is only applicable to the specific conditions. Exclusion of primary data collection as it would not be feasible to assess primary data of the entire global production of tallow. The limitations apply to all relevant life cycle stages, in particular cattle breeding, processing and tallow production. The literature sources used could not display all technologies and production pathways.													
Cut-off Criteria	The LCI study included all the flows which had more than 2% of the cumulative mass inputs and greater than 2 % of the cumulative energy of the respective gate-to-gate model inventory. Material flows which leave the system (emissions) and whose environmental impact was greater than 2% of the whole impact of an impact category that has considered in the assessment were covered. The sum of the neglected material flows must not exceed 5% of mass, energy or environmental relevance of the system inventory.													
Calculation Rules	Allocation	Economic allocation was applied due to the reason that cattle is cultivated for gaining meat, offals and hides (co-products). Economic allocation was applied in two steps in the product system: 1. Abattoir with co-products meat (carcasses to food), hides, offals/ bovine blood and rendering material 2. Rendering with co-products meat & bone meal and tallow												
	Aggregated data	The beef production system imputed in this study was a vertically integrated feed lot system, where the breeding herd and stockers are managed extensively.												
Life Cycle Inventory and Impact Assessment [2]														
Based on the LCI data an environmental impact assessment was performed for the indicators Primary Energy Demand (PED), global Warming Potential (GWP), eutrophication potential (EP) and acidification potential (AP). Other impacts may be calculated from the full LCI dataset. Table 1 shows the environmental impact results per 1 tonne of beef tallow.														
<p><u>Primary Energy Demand (PED)</u>: An analysis of the inventory data shows that primary energy is mainly demanded by diesel supply for tractor use during cattle breeding and cultivation of feed (pasture, soy and wheat). Further electricity and thermal energy supply for the abattoir and rendering process contributes with around 54% to the total primary energy demand.</p> <p><u>Global Warming Potential (GWP)</u>: An analysis of the inventory data shows that the main contribution of carbon dioxide comes from the rendering process (83% contribution). In the cattle breeding CO₂ emissions occur mainly feed cultivation, tractor use and diesel supply. Third biggest contributor of carbon dioxide emissions are the ones which occur due to electricity supply and thermal energy supply in the abattoir.</p> <p>The methane emission which contributes more to the GWP is the cattle breeding (96%). Other methane emissions result from the cultivation of wheat, diesel use and emissions from waste water treatment. The contribution of the nitrous oxide to the GWP comes from the cattle breeding during the manure management and feed cultivation (soy beans and wheat). Ammonia emissions occur with roughly 99% emitted by manure management.</p> <p><u>Air emissions related to Acidification (AP) and Eutrophication Potential (EP)</u>: An analysis of the inventory data shows that hydrogen sulphide is emitted during the provision of electricity which is required in the abattoir and rendering processes. Nitrogen monoxide is mainly emitted during the transport of intermediate products and nitrogen oxide emissions occur during the tractor use and the provision of electricity.</p> <p><u>Emissions to fresh water related to Acidification (AP) and Eutrophication Potential (EP)</u>: An analysis of the inventory data shows that nitrogen (from organic bound sources) and phosphate emissions to fresh water occur during the cultivation of wheat.</p> <p><u>Sensitivity Analysis</u>: Different sensitivity analysis were carried out. When considering economic allocation the results are lower; this is mainly due to the very low price of rendering material at the slaughterhouse compared to the main output meat.</p>														

Table 1. Global warming potential, acidification potential and eutrophication potential related to emissions to air and fresh water, and primary energy demand per 1 tonne of beef tallow

LCI result	Unit	Amount
Air emissions related to Global Warming Potential		
Carbon uptake, biotic	kg CO ₂ equiv.	-3954.26
Carbon dioxide, fossil	kg	827.06
Carbon dioxide, biotic	kg	55.62
Carbon dioxide, from land use, land use change and peat oxidation	kg	-
Methane	kg	51.21
Nitrous oxide (laughing gas)	kg	0.88
Air emissions related to Acidification and Eutrophication Potential		
Ammonia	kg	6.46
Hydrogen sulfide	kg	0.02
Nitrogen monoxide	kg	0.14
Nitrogen oxides	kg	1.27
Sulphur dioxide	kg	6.24
Emissions to fresh water related to Eutrophication Potential		
Nitrogen organic bound	kg	2.1
Phosphate	kg	0.505
Total GWP (according to [IPCC 2007]), including biotic carbon uptake		
	kg CO ₂ -Equiv.	-1529.14
EP	kg Phosphate-Equiv.	4.28
AP	kg SO ₂ -Equiv.	18.60
Primary energy demand		
Primary energy demand from renewable materials (net calorific value)	MJ	10415.9
Primary energy demand from fossil materials (net calorific value)	MJ	14366.3
Primary energy demand from fossil and renewable materials (net calorific value)	MJ	24782.2

References for the ERASM SLE Project	
Data Owner and Commissioner of the study	ERASM (Environment & Health Risk Assessment and Management). A research partnership of the Detergents and Surfactants Industries in Europe (www.erasm.org)
LCA Practitioner	thinkstep AG (www.thinkstep.com)
Reviewers	Prof. Walter Kloepffer, LCA Consult Mrs. Charlotte Petiot and Dr. Yannick Leguern, BioS by Deloitte
References	<p>[1] Daniel Swern (1979). Bailey’s Industrial oil fat products, volume 1.</p> <p>[2] Schowanek. D. <i>et al.</i> (2017). New and Updated Life Cycle Inventories for Surfactants used in European Detergents: Summary of the ERASM Surfactant Life Cycle and Ecofootprinting Project. Int J. LCA, in press.</p> <p>[3] CEFIC-Franklin (1994). Resource and environmental profile analysis of petrochemical and oleo chemical surfactants produced in Europe. Phase II Final Report, Franklin Associates, LTD.</p> <p>[4] Matravers (2000). Papers of the inquiry into the emergence and identification of Bovine Spongiform Encephalopathy (BSE) and variant Creutzfeldt-Jakob Disease (vCJD) and the action taken in response to it up to 20 March. London: The Stationery Office.</p> <p>[5] DARPRO (2012). Material Safety Data Sheet: Beef Tallow.</p>

Figure 1. Process for producing Tallow.

