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Review

Meat processing waste as a potential feedstock for biochemicals and biofuels – A review of possible conversion technologies

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ABSTRACT

Rising sustainability concerns due to the increasing threats of environmental degradation as well as increments in prevailing global temperatures have motivated an intensified research into sustainable biomass technologies. Indeed environmental theorists have consistently emphasised the inevitable need for a paradigm shift from fossil based fuels and chemicals if imminent environmental catastrophe is to be averted. While the utilisation of biomass as feedstock for biofuel production has been well reported in the literature the poor economic performance of such 'stand-alone' systems has led to attempts to maximise value extraction via the exploration of the biorefinery concept.

This paper therefore proposed the utilisation of the waste streams from meat processing plants as a suitable biorefinery feedstock. This proposal is supported by the recognised product specific characteristic of the waste stream implying an unavoidable accumulation, which may also be considered as indicative of sustainable supply. A review of the existing practises in meat processing waste stream management and utilisation has been explored with the unsustainability of the current landfill disposal and incineration practices firmly established. Possible biomass conversion technologies as well as the possible product streams are explored, with this analysis culminating in the presentation of a structured computer aided biorefinery synthesis and design approach that will facilitate an efficient biorefinery design process.

Contents

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1. Introduction

1.1. Meat processing organic waste and the bio refinery pathway

A biorefinery may be considered as a system that guarantees a unified approach in the generation of valuable materials and biofuels via the integration of biomass conversion processes (Suwelack and Wüst, 2015). It is therefore comparable to an oil refinery since the concept explores the possibility of converting biomass from a range of sources into high-specification fuels and chemicals.

While the biorefinery concept is not new as illustrated by the availability of over 650 related publications, the recent upsurge in the exploration of the concept as illustrated by the increased cross disciplinary transitions is a clear indication of increasing environmental and economic concerns (Dusselier et al., 2014). Indeed the price volatility and the supply unreliability of fossil dependent products emphasises the need for the development of alternative energy carriers and biochemicals that will guarantee a more sustainable future while simultaneously reducing the environmental impact (Cherubini, 2010).

Bachmann and Riese (2006) subsequently suggested that the utilisation of waste streams as promising alternative feedstock for biorefineries with the magnitude of meat processing waste suggesting sustainable supply. According to FAO (2015), global annual meat consumption increased by 1.9% annually from 2000 to 2015 and is expected to increase by 1.5% yearly from 2015 to 2030, a trend indicative of a geometric increase. Furthermore given that 21, 898 tonnes of meat is processed from 1997 to 1999, the aggregate future waste generated can be estimated. Since according to Marculescu et al. (2015), about 33 wt % of the meat processed becomes waste, the total waste expected to be generated between 2015 and 2030 can be determined as follows[1];

$$MW_{2015-2030} = M_0(0.33)(1.019)^{16}\left(\frac{1.015^{16}-1}{0.015}\right) \quad (1)$$

where

[1] The calculation is based on summation approach of geometric progressions.

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