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Research Article

Anaerobic Digestion of Tomato Wastes from Groceries Leftovers: Effect of Moisture Content

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Abstract

Glasshouse farming has essentially expanded the creation of vegetables and lessened reliance on ecological conditions. In Mediterranean regions, vegetable products are these days a standout amongst the most imperative provenances of an organic waste formation. Anaerobic assimilation is among the strategies utilized to treat this sort of biodegradable waste. This paper aims to study the effect of moisture content on tomato wastes anaerobic digestion that discarded by groceries in Babylon city in Iraq in order to enhance biogas production. The procedure is performed by using three batch anaerobic digesters which fed by tomato leftovers. The PH of three feeding substrates is adjusted to 5 by using (40% NAOH solution of PH 11.13).Three different moisture content are fed to the digesters (94.4% ,96.5% and 99%). The biogas produced from digesters 1,2,3 are (198,210,231 ml/g) vs respectively. According to the result of this paper , the biogas production is increased as moisture content increased and the tomato wastes is an appropriate substrate for anaerobic digestion process.

Keywords: *Glasshouse farming, Anaerobic Digestion, tomato wastes, moisture content etc.*

1. Introduction

Tomato (Solanum Lycopersicum) is the second most created vegetable on the planet, with about 164 Mt produced only in 2013(FAOSTAT, 2015). Weather and soil assorted qualities in Iraq makes it useful for tomato creation over the entire year using advanced development methods and crossbred seeds. In the winter, tomatoes are being delivered in the wilderness zone of al-Zubayr and Samawa and in spring from Diwaniya manors, together with and Najaf and Karbala. In the late spring, tomatoes are delivered in the Kut fields, in Nu'maniyah and furthermore regions of Diyala and Al khales. In fall generation is from Kirkuk, Mosul and Sinjar (cropscience ,2008).

The carbon impression of house units refuse of tomato items in the UK is 853,000 tons for every year. Almost 99% of the carbon impression gets from the avoidable trash of tomato products. The carbon impression of tomatoes can shift fundamentally contingent upon whether they are cultivated in a farm or in a glasshouse and upon how glasshouses are warmed (Wiltshire *et al*.,2009).

Tomato (Lycopersicon esculentum Solanaceae) extraction is the most critical vegetable juice regarding per capita utilization, trailed via carrot extraction. As indicated by measurements from the World Handling Tomato Bureau, more than 30 million tons of tomatoes are treated every year worldwide to deliver tomato juice, ketchup, canned tomatoes, and numerous different items (WPTC, 2013). through tomato treatment, a junk recognized as tomato pomace is created. This element forms around 5% by weight of the treated tomatoes and comprises primarily of tomato peels, mash scraps, and seeds. Tomato pomace has no business esteem and is as of now discarded as a solid waste or utilized to a restricted degree for creature nourishment. In any case, a cautious examination of the properties of tomato pomace uncovers that it is a rich provenance of supplements and important phytochemicals. Specifically, critical phenolics and carotenoids are available in the peel division of the refuse (Zuorro *et al*., 2014). Tomato pomace comprises of the dried and squashed skins and seeds of the natural product. The seeds represent roughly 10% of the fruitiness and 60% of the whole waste, individually, and are a root of protein (35%) and fat (25%) (Bhullar and Sogi, 2000).

2. Materials and Methods

1) Water bath
2) Thermometer
3) Rubber tube
4) Three plastic bottles (1.5L) as digesters
5) Nine bottles of (250ml) volume for gas upgrading and biogas volume calculation purposes.

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(1.5 kg) of tomato was collected from groceries leftover. This quantity was exposed to biological, mechanical and chemical pre-treatment in order to enhance biogas production.

This quantity divided into three groups, each one represents (500g) which feeding to the plastic digesters later. Before feeding into digesters, these groups of tomato treated biologically by introducing them to air in order to stimulate their biodegradability to access the required microorganisms for anaerobic digestion process. Then they are shredded via knife to small parts and then crushed by blinder to make their available to microorganisms to accelerate assimilation of substrate. The substrate was feeding at different moisture content.

Also chemical pre-treatment was included as alkali pre-treatment by using (40% NAOH) solution to adjust PH value to appropriate range for hydrolysis stage. The characteristics of substrate utilized obvious at table below.

Characteristics of utilized substrates

Features	Digester 1	Digester 2	Digester 3
Moisture content (%)	94.4	96.5	99
PH value	4.11	4.3	4.35
Adjusted PH	5	5	5

The digesters operated at mesophilic range by putting their into water bath to maintain working temperature at 45C. Each digester connects to (250 ml) pyrex which contains (50% NAOH) solution for biogas upgrading. The produced biogas was measured by using water displacement method. For more clearance, see figure below:

Figure 1: Biogas production system

The moisture content adjusted to the desired value by using distilled water. High dampness percent, as a rule, promote the anaerobic processing; in any case, it is hard to keep up a similar accessibility of water all through the digestion cycle (Hernandez-Berriel *et al*., 2008). At first, water included at a high rate is declined to a specific lower level as the procedure of anaerobic processing continues. High water percent are probably going to influence the procedure execution by dissolving promptly degradable organic matter. It has been accounted for that the most astounding methane creation rates happen at 60–80% of humidity (Bouallagui *et al*., 2003).

3. Results and discussion

Figures 2,3,4 shows the specific biogas production of each digester. It is noted that as moisture content of substrate increased the production of biogas is also increased, which means the added distelled water provides more contact between microorganism and organic molecules. Therefore, enzymes are accessed to assimilate complex organic matter to simple and dissolved particles (volatile fatty acids)that converted to biogas by methanogenesis later. Digester 1 shows the less biogas production, on the other hand Digester 3 shows the best result.

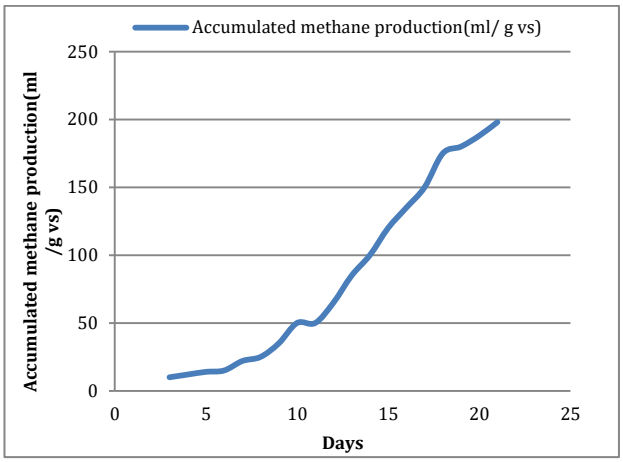

Figure 2: Accumulated methane produced from digester 1

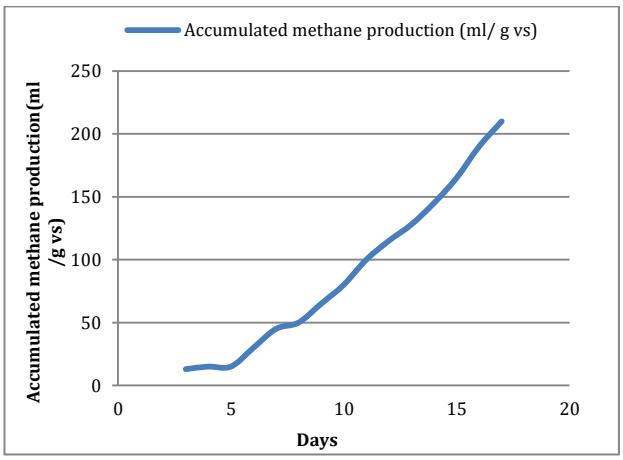

Figure 3: Accumulation methane produced from digester 2

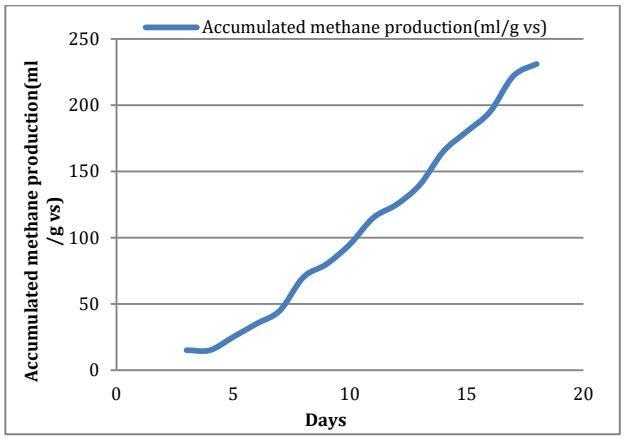

Figure 4: Accumulation of methane production from digester 3

Methanogenesis forms through anaerobic processing at various dampness levels i.e., 70% and 80%. They found that the 385 starting of the methanogenic stage occurred around day 70 in both cases, at 70% and 80% dampness. Be that as it may, bioreactors under the 70% dampness condition formed a more grounded leachate and therefore a higher methane generation rate. Toward the finish of the trial, 71 ml methane per gram dry matter were formed at the 70% dampness level, while 83 ml methane per gram dry matter were created with the 80% dampness (Hernandez-Berriel *et al.* ,2008).

There is an enhancement in the biogas production from digesters 1,2 over digester 1 by approximately 1% . The biodegradable of substrate and the formation of biogas after hydrolysis of complex organic content to volatile fatty acids in digesters 2,3 are more stable than digester 1 due to improvement in the digestion medium and the nutrients become valid for microorganisms which results in rapid assimilation of organic content and appropriate contact between substrate and organisms.

Conclusions

Alkali pretreatment causes the accumulation of salts. The addition of distilled water to increase the moisture content of reaction medium results in an improvement in the biogas production. As moisture content increased the biogas creation also increased. The biogas produced from digesters round from (198 ml/ g vs) to (231 ml/ g vs).

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