A Historiography analysis of Biodiesel research output: With special Reference to Asia

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Abstract

This study has been carried out to histographic analyze Biodiesel research in terms of publication output as per Web of science citation index database between 1999 and 2013. A quantitative analysis on the countries and organizations that contribute in histographic analyze Biodiesel. The data shows increase in the basic research activity in this research field. During 1999-2013, a total of 11020 papers were published by the scientists in the field of sago. For Asian Countries we have also identified the key researchers and institutions. Using Histcite, the visualization technique developed by Garfield and colleagues. We have constructed the histographs for asian countries based on local citation score and global citation scores, and identified key papers.

Keywords

Histography; Biodiesel Research; Asia

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1. INTRODUCTION

Scientometrics' and histographic analysis the branch science of science that describes the output traits in terms of organizational research structure, resource inputs and outputs, develops benchmarks to evaluate the quality of information output. Scientometric studies characterize the disciplines using the growth of the pattern and other attributes. These studies have potential particularly in assessing the emerging disciplines(S. Arunachalam & Garg, 1985). In the present study, we are doing the histographic study of the research performance on Biodiesel, a significantly growing area in the knowledge driven world. Biodiesel research is analyzed and compared with number of document, journals, and international collaboration from 1999 to 2013. Using HistCite, the visualization technique developed by Garfield and colleagues, the historiographs for India based on both local citation scores (LCS) and global citation scores have been constructed, and the key papers have been identified.

2.METHODOLOGY

The data for the study were retrieved from web of science database which is a scientific and indexing service maintained by Thomson Reuters. The research productivity of Nanosensors was analyzed using various scientometric indicatiors. The following search strategy has been used to extract data for the study.

TITLE-ABS-KEY ("Nanosensor") AND PUBYEAR (All years)

The bibliographic details such as authors, document types, collaboration etc were analyzed using Histcite which is a software package used for bibliometric analysis and information visualization.

3. ANALYSIS

A total of 11020 records were published by the by researchers in the field of Biodiesel. The research output was analyzed using various scientometric indicators.

3.1. Histographic Analysis of Biodiesel Research in Asia

The number of papers published from different countries during 1999-2013 is shown in the fig 1. The USA is the undoubted leader, followed by India,

China, Japan , South Korea , Malaysia and Turkey. The growth of biodiesel research in several Asian countries , USA and the world as a world as shown in the table 1, as a time series of number of papers published annually over a period of 14 years. There has been a dramatic rise in biodiesel research only in the 2009 in all the countries considered. Although in the early year upto 2009 - there was not much difference in the annual publication outputs of China and USA in the year 2013. China may be overtaken USA because of the data was not completed. India was ahead of China followed by Japan, Malaysia, Turkey, South Korea and Sri Lanka till 2005, but in later year China raced ahead of India. For the period of 1999-2013 India shares less than 50%, of the share of USA and less than 71% of the share of China. When compare to Japan, Malaysia, Turkey, South Korea and Sri Lanka, India published higher number of research outputs. Even small country like Malaysia has a publication outputs comparable to that of India.(Karpagam, Gopalakrishnan, Natarajan, & Ramesh Babu, 2011)

Table 1: Distribution of publication on Biodiesel from selected countries and the world by year [data from WOS 1999-2013

Year	World	India	China	Japan	Malaysia	Turkey	South Korea	Sri Lanka	USA
1999	40	1	0	2	0	1	0	0	17
2000	46	2	0	4	0	2	0	0	20
2001	51	1	2	11	0	2	0	0	19
2002	56	1	0	7	1	2	1	1	11
2003	100	5	10	3	0	6	1	5	19
2004	115	8	8	13	0	5	3	5	27
2005	193	16	8	10	5	13	3	1	51
2006	321	21	38	12	5	12	6	4	61
2007	608	32	60	32	5	32	8	3	163
2008	875	58	95	34	12	56	27	5	166
2009	1,239	106	122	57	43	73	38	5	222
2010	1,635	148	206	59	71	67	52	4	296
2011	2,015	190	239	50	104	98	51	3	363
2012	2,162	215	304	50	95	87	81	6	357
2013*	1,584*	145*	239*	44*	89*	29*	80*	6	255*
1999-2013	**11,020**	**949**	**1,331**	**388**	**430**	**485**	**351**	**47**	**2,047**

Data for 2013 not complete.

3.2 Historiography of Biodiesel in India

The historiograph constructed from biodiesel India collection consisting of 949 records and 9620 citation reference. Figure 1 (LCS India) is the Historiography of biodiesel research in India based on the 50 most highly cited paper in the biodiesel Indian collection based on their LCS . Figure 2 (GCS India) is a similar historiography but based on the GCS. Both covered the period 1999-2013, although we collected data on biodiesel research from 1999. The papers published up to 1998 have not found a place in these historiographs, indication that they have not proven to be significant. (Balasubramani & Murugan, 2011)

In both the LCS of biodiesel in India historiographs, the story beings a B. K. De* and D. K. Bhattacharyya in Fett/Lipid journal in 1999. In GCS of biodiesel in India Historiographs, the story begins with Anjana srivastava and Ram Prasad in renewable and sustainable energy reviews in 2000.

The prominent node in the GCS historiography are 3 (Srivastava, 12 citation links), 4 Agarwal 5 citation links), 25 (Ramadhas 6 citation links), 29 (Barnwal 7 citation links) and 69 (Agarwal 4 citation links).

The prominent node in LCS Historiograph 3 (Srivastava, 16 citation links), 4 Agarwal 8 citation links), 7 (Pramanik 7 citation links), 29 (Barnwal 7 citation links), 30 (karmee 5 citation links), 22 (Azam 3citation links) and 45 (Meher 3 citation links).

In Paper No 7, K. Pramanik (2003), in the present investigation the high viscosity of the jatrosphacurcas oil which has been considered as a potential alternative fuel for the compression ignition (C.I.) engine was decreased by blending with diesel. The

blends of varying proportions of jatrophacurcas oil and diesel were prepared, analyzed and compared with diesel fuel. This study concluded thermal efficiencies of the engine were obtained with blends containing up to 50% volume of jatropha oil was used in CI engine.

In paper 3, AnjanaSrivastava, (2000) the need of research is to search the alternative for diesel fuels, mainly for standpoint of preserving the global environment. Among the different possible sources, diesel fuels derived for vegetable oil and animal fats (triglyceride). Fatty acid methyl ester is known as biodiesel, derived by transesterification, The main advantages of using biodiesel are its renewability, better-quality exhaust gas emissions, its biodegradability and given that all the organic carbon present is photosynthetic in origin, it does not contribute to a rise in the level of carbon dioxide in the atmosphere and consequently to the greenhouse effect.

In paper No 29, Barnwal, BK (2005), examine the work done on biodiesel production and utilization, resources available, process developed performance in existing engines, environmental consideration, the economic aspect and advantage in and barriers to the use of biodiesel.Ramadhas, AS, in most of the biodiesel is produced from the refine/edible type oil using methanol and an alkaline catalyst, but in this paper (25) examined unrefined rubber seed oil. These unrefined rubber seed oil contain large amount of fatty acid (FFA), it is difficult to alkaline-esterification, they taken two step esterification processes, and it convert methyl ester. Some important properties of biodiesel found out and compared with that of diesel in 2005.

In paper no 45, L.C. Meher (2006) they summarized technical tools and process of monitoring the transesterification reaction. In addition, fuel properties and specification provided by different countries are discussed.

In paper no 69 ,Agarwal, AK (2007) review the production , characterization and current statues of vegetable oil and biodiesel as well as the experimental research work carried out in various countries .This review focuses on performance and emission of biodiesel in CI engines, combustion analysis, wear performance on long term engine usage and economic feasibility.

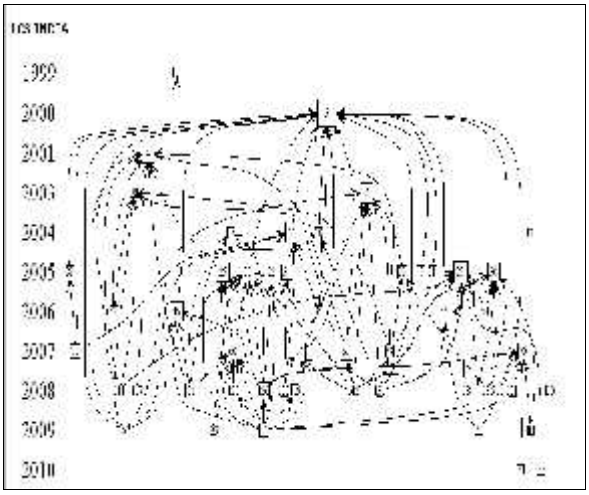


Figure 1: Historiograph of Biodiesel Research in India Bases on the Local Citation Score. *Nodes: 30, Links: 102LCS, top 50; Min: 12, Max: 103 (LCS scaled)*

Sl No	Node	Details of the Papers	LCS	GCS
1.	1	De BK, 1999, FETT-LIPID, V101, P404	12	23
2.	3	Srivastava A, 2000, RENEW SUST ENERG REV, V4, P111	103	553
3.	4	Agarwal AK, 2001, J ENG GAS TURB POWER, V123, P440	45	153
4.	7	Pramanik K, 2003, RENEW ENERG, V28, P239	54	201
5.	8	Agarwal AK, 2003, J ENG GAS TURB POWER, V125, P604	12	27
6.	11	Raheman H, 2004, BIOMASS BIOENERG, V27, P393	54	137
7.	12	Shah S, 2004, ENERG FUEL, V18, P154	21	133
8.	17	Madras G, 2004, FUEL, V83, P2029	13	155
9.	18	Meher LC, 2004, J SCI IND RES INDIA, V63, P913	13	28
10.	19	Puhan S, 2005, BIOMASS BIOENERG, V28, P87	20	68
11.	20	Ghadge SV, 2005, BIOMASS BIOENERG, V28, P601	46	176

12.	21	Subramanian KA, 2005, BIOMASS BIOENERG, V29, P65	25	62
13.	22	Azam MM, 2005, BIOMASS BIOENERG, V29, P293	63	191
14.	25	Ramadhas AS, 2005, FUEL, V84, P335	51	278
15.	26	Ramadhas AS, 2005, RENEW ENERG, V30, P795	25	83
16.	28	Puhan S, 2005, RENEW ENERG, V30, P1269	21	53
17.	29	Barnwal BK, 2005, RENEW SUST ENERG REV, V9, P363	59	258
18.	30	Karmee SK, 2005, BIORESOURCE TECHNOL, V96, P1425	47	153
19.	31	Ramadhas AS, 2005, RENEW ENERG, V30, P1789	31	116
20.	35	Ghadge SV, 2006, BIORESOURCE TECHNOL, V97, P379	16	100
21.	45	Meher LC, 2006, RENEW SUST ENERG REV, V10, P248	69	733
22.	46	Meher LC, 2006, BIORESOURCE TECHNOL, V97, P1392	53	137
23.	53	Agarwal D, 2006, RENEW ENERG, V31, P2356	17	76
24.	54	Sreeprasanth PS, 2006, APPL CATAL A-GEN, V314, P148	15	78
25.	60	Sahoo PK, 2007, FUEL, V86, P448	36	93
26.	69	Agarwal AK, 2007, PROG ENERG COMBUST, V33, P233	52	480
27.	70	Sarin R, 2007, FUEL, V86, P1365	36	151
28.	71	Tiwari AK, 2007, BIOMASS BIOENERG, V31, P569	35	182
29.	73	Agarwal D, 2007, APPL THERM ENG, V27, P2314	20	82
30.	79	Raheman H, 2007, FUEL, V86, P2568	28	55

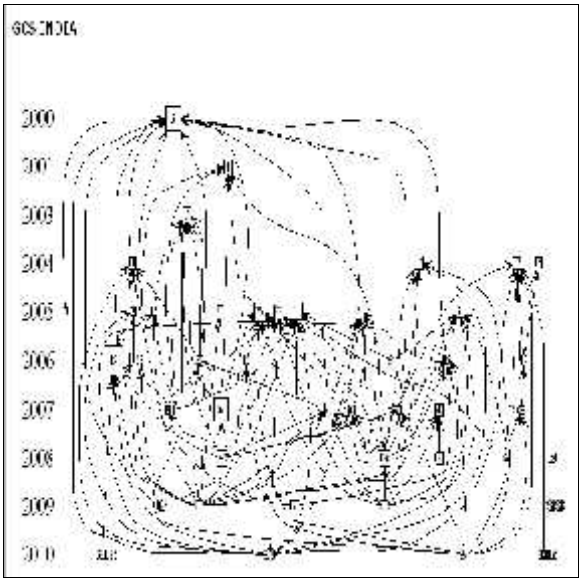


Figure 2: Historiograph of Biodiesel Research in India Bases on the Global Citation Score. *Nodes: 50, Links: 102 GCS, top 50; Min: 12, Max: 103 (GCS scaled)*

Sl No	Node	Details of the Papers	LCS	GCS
1.	3	Srivastava A, 2000, RENEW SUST ENERG REV, V4, P111	103	553
2.	4	Agarwal AK, 2001, J ENG GAS TURB POWER, V123, P440	45	153
3.	7	Pramanik K, 2003, RENEW ENERG, V28, P239	54	201
4.	11	Raheman H, 2004, BIOMASS BIOENERG, V27, P393	54	137
5.	12	Shah S, 2004, ENERG FUEL, V18, P154	21	133
6.	16	Gupta MN, 2004, EUR J BIOCHEM, V271, P2575	3	126
7.	17	Madras G, 2004, FUEL, V83, P2029	13	155
8.	19	Puhan S, 2005, BIOMASS BIOENERG, V28, P87	20	68
9.	20	Ghadge SV, 2005, BIOMASS BIOENERG, V28, P601	46	176
10.	21	Subramanian KA, 2005, BIOMASS BIOENERG,	25	62

		V29, P65		
11.	22	Azam MM, 2005, BIOMASS BIOENERG, V29, P293	63	191
12.	25	Ramadhas AS, 2005, FUEL, V84, P335	51	278
13.	26	Ramadhas AS, 2005, RENEW ENERG, V30, P795	25	83
14.	29	Barnwal BK, 2005, RENEW SUST ENERG REV, V9, P363	59	258
15.	30	Karmee SK, 2005, BIORESOURCE TECHNOL, V96, P1425	47	153
16.	31	Ramadhas AS, 2005, RENEW ENERG, V30, P1789	31	116
17.	35	Ghadge SV, 2006, BIORESOURCE TECHNOL, V97, P379	16	100
18.	39	Shah S, 2006, ANAL BIOCHEM, V351, P207	2	67
19.	42	Meher LC, 2006, EUR J LIPID SCI TECH, V108, P389	11	64
20.	45	Meher LC, 2006, RENEW SUST ENERG REV, V10, P248	69	733
21.	46	Meher LC, 2006, BIORESOURCE TECHNOL, V97, P1392	53	137
22.	53	Agarwal D, 2006, RENEW ENERG, V31, P2356	17	76
23.	54	Sreeprasanth PS, 2006, APPL CATAL A-GEN, V314, P148	15	78
24.	60	Sahoo PK, 2007, FUEL, V86, P448	36	93
25.	63	Shah S, 2007, PROCESS BIOCHEM, V42, P409	5	96
26.	64	Modi MK, 2007, BIORESOURCE TECHNOL, V98, P1260	9	73
27.	69	Agarwal AK, 2007, PROG ENERG COMBUST, V33, P233	52	480
28.	70	Sarin R, 2007, FUEL, V86, P1365	36	151
29.	71	Tiwari AK, 2007, BIOMASS	35	182
		BIOENERG, V31, P569		
30.	73	Agarwal D, 2007, APPL THERM ENG, V27, P2314	20	82

3.3 Historiograph for Biodiesel in China

Figure 3 (LCS) and 4 (GCS) are the historiograph constructed from biodiesel china collection consisting of 1331 records and 7002 citation reference. In both these the first key paper is the 2001 journals of molecular catalyst –B enzyme by Iso paper no 2. In both these figures, the following nodes are found to be prominent 2, 17, 39, 61 and 413. In addition, node number 31 (LCS) and 127 (GCS) also seem to be important from the historiograph.

In paper No : 31, WenleiXiea (2006) showed that an environmentally benign process for the transesterification of soybean oil to methyl esters using alumina loaded with potassium as a solid base catalyst in a heterogeneous manner was developed. The effects of various reaction variables such as the catalyst loading, oil to methanol ratio, reaction time and temperature on the conversion of soybean oil were investigated. The results indicated that K_2O derived from KNO_3 at high temperature and that the Al–O–K groups were, probably, the main reasons for the catalytic activity towards the reaction. The catalyst activity was correlated closely with its basicity as determined by the Hammett method.(Pratheepan & Weerasooriya, 2016)

In Paper No: 2, Mamoru Iso(2001) was performed Transesterification reaction using triglycerides and short-chain alcohol by immobilized lipase in non-aqueous conditions. The long-chain fatty acid ester, which is the product of this reaction, can be used as a diesel fuel that does not produce sulfur oxide and minimize the soot particulate. Immobilized *Pseudomonas fluorescens* lipase showed the highest activity in this reaction. The activity of immobilized lipase was highly increased in comparison with free lipase because its activity sites became more effective. Immobilized enzyme could be repeatedly used without troublesome method of separation and the decrease in its activity was not largely observed.

In Paper No: 39, Xiaoling Miao (2005) the study introduced an integrated method for the production of biodiesel from microalgal oil. Heterotrophic growth of Chlorella protothecoides resulted in the accumulation of high lipid content (55%) in cells. Large amount of microalgal oil was efficiently from these heterotrophic cells by using n-hexane. The results suggested that the new process, which combined bioengineering and transesterification, was

a feasible and effective method for the production of high quality biodiesel from microalgal oil.(Pratheepan, 2013)

In Paper No: 61, Han Xu (2005) to obtain high quality biodiesel production from a microalga *Chlorella protothecoids*through the technology of transesterification. The result showed that cell density significantly increased under the heterotrophic condition, and the highest cell concentration reached. Large amount of microalgal oil was efficiently extracted from the heterotrophic cells by using *n*-hexane, and then transmuted into biodiesel by acidic transesterification. The biodiesel was characterized by a high heating value , a density , and a viscosity . In these they suggested that the new process was a low-cost, feasible, and effective method for the production of high quality biodiesel from microalga.

In paper No: 127, Chun-Hui (Clayton) Zhou (2007) provides a comprehensive review and critical analysis on the different reaction pathways for catalytic conversion of glycerol into commodity chemicals, including selective transesterification, selective etherification, oligomerization and polymerization, and conversion of glycerol into glycerol carbonate. Glycerol is currently produced in large amounts during the transesterification of fatty acids into biodiesel and as such represents a useful by-product. Finally, we note that a crucial issue in both current and future biodiesel production is economic viability, specifically enhanced by the profitable use of glycerol by-products and waste streams. Subsequently, one of the real challenges is that glycerol obtained as a by-product from the biodiesel industry is crude and impure.

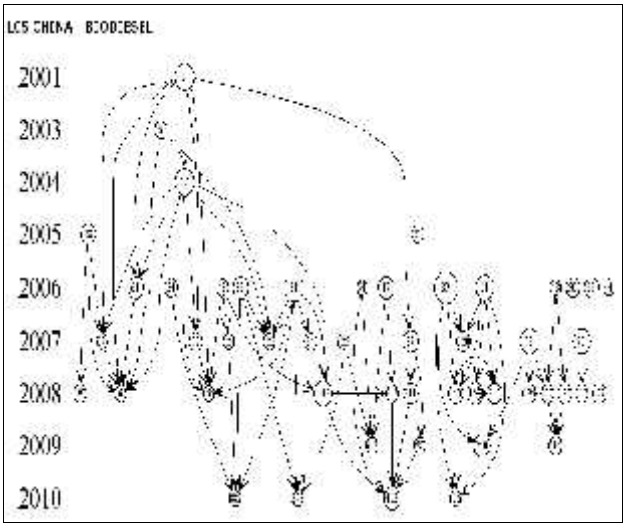


Figure 4: Historiograph of Biodiesel Research in China Bases on the Local Citation Score. *Nodes: 50, Links: 69LCS, top 50; Min: 15, Max: 63 (LCS scaled)*

Sl No	Node	Details of the Papers	LCS	GCS
1.	2	Iso M, 2001, J MOL CATAL B-ENZYM, V16, P53	44	218
2.	6	Xu YY, 2003, BIOTECHNOL LETT, V25, P1239	20	76
3.	17	Du W, 2004, J MOL CATAL B-ENZYM, V30, P125	45	200
4.	21	Cao WL, 2005, FUEL, V84, P347	19	114
5.	28	Du W, 2005, J MOL CATAL B-ENZYM, V37, P68	27	77
6.	31	Xie WL, 2006, APPL CATAL A-GEN, V300, P67	44	222
7.	34	Xie WL, 2006, CATAL LETT, V107, P53	23	106
8.	38	Xie WL, 2006, J MOL CATAL A-CHEM, V246, P24	30	169
9.	39	Miao XL, 2006, BIORESOURCE TECHNOL, V97, P841	63	292
10.	43	Zhu HP, 2006, CHINESE J CATAL, V27, P391	18	64
11.	44	Leung DYC, 2006, ENERG FUEL, V20, P1015	16	35
12.	47	Wang Y, 2006, J MOL CATAL A-CHEM, V252, P107	30	124
13.	48	Xue FY, 2006, PROCESS BIOCHEM, V41, P1699	16	51
14.	50	Xie WL, 2006, J MOL CATAL A-CHEM, V255, P1	24	132
15.	54	Leung DYC, 2006, FUEL PROCESS TECHNOL, V87, P883	15	172
16.	61	Xu H, 2006, J BIOTECHNOL, V126, P499	40	205
17.	64	Li LL, 2006, J MOL CATAL B-ENZYM, V43, P58	31	123
18.	65	Nie KL, 2006, J MOL	27	119

		CATAL B-ENZYM, V43, P142		
19.	69	Du W, 2007, GREEN CHEM, V9, P173	15	39
20.	70	Wang Y, 2007, ENERG CONVERS MANAGE, V48, P184	37	132
21.	84	Chai F, 2007, ADV SYNTH CATAL, V349, P1057	21	73
22.	87	Zong MH, 2007, GREEN CHEM, V9, P434	31	103
23.	92	Liu XJ, 2007, CATAL COMMUN, V8, P1107	22	112
24.	98	Li YH, 2007, ENZYME MICROB TECH, V41, P312	40	124
25.	120	Li XF, 2007, BIOTECHNOL BIOENG, V98, P764	25	110
26.	123	Wu Q, 2007, IND ENG CHEM RES, V46, P7955	19	50
27.	124	Li X, 2007, CATAL COMMUN, V8, P1969	15	51
28.	125	Shu Q, 2007, CATAL COMMUN, V8, P2159	15	58
29.	127	Zhou CHC, 2008, CHEM SOC REV, V37, P527	24	410
30.	140	Xiong W, 2008, APPL MICROBIOL BIOT, V78, P29	27	104

4 . CONCLUSION

Due to technological importance and expected economic activity, biodiesel has been intensively investigated by histographic methods. In this paper, the current status of biodiesel and has been presented(Gunasekaran & Balasubramani, 2012). The aim of the study is to illustrate the different approaches in highly cited papers have dealt with this emerging area so far and presented a variety of data. This raises the question to what extent the data presented can provide useful information to various stakeholders, such as scientists and engineers working in one of the fields related to biodiesel, decision-makers in R&D administrations and industry. Some of the histographic data may be of interest to researchers in the field.(Abu, Science, & 2015, n.d.) This study presented a summary of histographic research in the nanotechnology area. Using publication of literature, an overview of histographic efforts have been presented to trace the emergence of this new technological area. The paper has also presented data that gives an idea about which countries are the most active in terms of scientific publications in biodiesel.

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