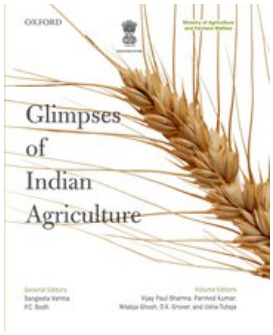

Glimpses of Indian Agriculture

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- Comprehensively studies different facets of agriculture and allied sectors
- Provides an overview of the Indian agriculture sector
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Description

Agriculture and allied sectors, unquestionably, are considered to be the largest source of livelihood in India contributing largely to the GDP of the country. However, despite a significant increase in the production of food grains, the agriculture sector has been facing innumerable challenges primarily because of its dependency on natural resources, which have shrunk due to increasing demographic and socioeconomic pressures. This book, a study assigned by the Ministry of Agriculture, studies different facets of agriculture and allied sectors. It provides an overview of Indian agriculture, and presents an analysis of its performance over the years. Showcasing the issues faced in the development of agriculture, it captures the interventions and initiatives of the government for the development of Indian agriculture.

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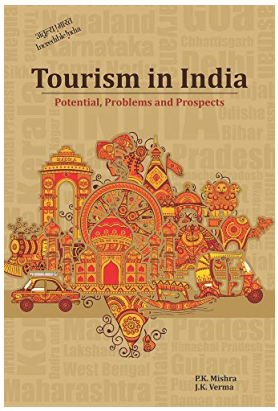

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P. K. Mishra and J. K. Verma

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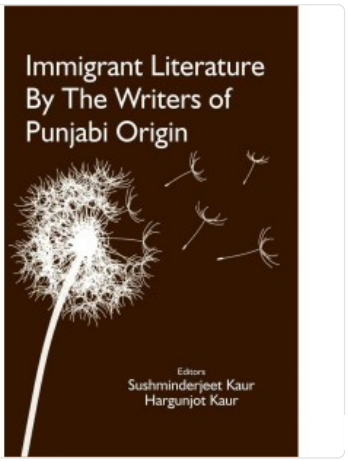

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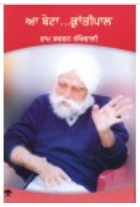
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A study on monitoring of frying performance and oxidative stability of virgin coconut oil (VCO) during continuous/prolonged deep fat frying process using chemical and FTIR spectroscopy

Yashi Srivastava [1], Anil Dutt Semwal [1]

Affiliations

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Abstract

The performance or quality of the Virgin coconut oil (VCO) during continuous/prolonged deep fat frying of soaked bengal gram dhal was evaluated at 180 °C ± 5 °C for 8 h with the help of physico-chemical and rheological parameters. Chemical changes indicated that the free fatty acid (FFA) content and TBA increased significantly ($p \leq 0.05$) from 0.11 to 0.98 % lauric acid and 0.06 to 0.61 malonaldehyde/kg of oil respectively. Initially, the peroxide value (PV) of VCO sample was 3.25 meqO2/kg which increased to 9.12 meqO2/kg after 6 h of frying but at the end of frying the value of PV was again found to decrease (8.01 meqO2/kg). The regression coefficients (R(2)) between CD232, CT270 and frying time were 0.964 and 0.983 respectively. The L*, a* and b* colour values measured on the CIELAB colour scale showed a decrease in L* and increase in a*, b* values after 8 h of continuous frying. The p-AV and total polar compounds were increased significantly ($p \leq 0.05$) from 2.41 to 17.93 and 2.77 to 8.14 % respectively. Initially, the viscosity of VCO was 49.87cp which increased to 69.87cp after 8 h of continuous frying. The FTIR spectra justify that VCO samples after 8 h of frying found to be stable and acceptable as there was no change occurred at 1,739 cm(-1) frequency which mainly corresponded to carbonylic compounds resulted from the hydroperoxide decompositions after 8 h of continuous frying.

Keywords: FTIR; Peroxide value (PV); Specific absorptivity; Total polar compounds; Virgin coconut oil (VCO); Viscosity.

Figures

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Structural Stability, Electronic and Dielectric Properties of Ethanethiol Adsorbed Au Layer

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Source: Advanced Science Letters, Volume 24, Number 2, February 2018, pp. 864-866(3)
Publisher: American Scientific Publishers
DOI: https://doi.org/10.1166/asl.2018.10862

Abstract | References | Citations | Supplementary Data | Suggestions

A first principle study of structural stability, electronic and dielectric properties of pristine and ethanethiol adsorbed Au atomic layer have been carried out within the framework of density functional theory (DFT). The ethanethiol energetically favors the Bond site adsorption on Au monolayer among other studied sites. The adsorption of ethanethiol leads to decrease in quantum ballistic conductance of Au monolayer from $4G_0$ to $2G_0$. A blue shift of 0.10 eV and 0.25 eV has been found in imaginary part of dielectric function (ε_2) and electron energy loss spectra (EEL) of pristine Au atomic layer respectively. These results suggest that Au atomic layers may hold a key towards sensing applications.

Keywords: Ballistic Conductance; DFT; Electronic Structure

Document Type: Research Article

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Abstract

Different types of nanomaterials possess excellent physical and chemical properties. Nanoparticles (NPs) have been implicated for use in drug and gene delivery. Several in vitro and in vivo studies suggest the cytotoxic and proinflammatory potential of NPs. Further, parenteral administration of NPs results in their accumulation in several tissues. The possible mechanism of toxicity appears to be production of free radicals, mitogen activated protein kinase (MAPK) activation and translocation of transcription factors from cytoplasm to nucleus. This leads to induction of apoptosis, growth arrest, and cell death. Further, factors like nuclear factor-κB (NF-κB) lead to production of proinflammatory cytokines. The present review focuses on the cytotoxicity, biodistribution, and mechanism of NPs toxicity with special emphasis on carbon nanotubes (CNTs) toxicity.

Keywords

Nanoparticles Oxidative stress Nanotoxicity Proinflammatory cytokines Genotoxicity Quantum dots Carbon nanotubes

Abbreviations

ADME	Absorption, distribution, metabolism, and excretion
Akt	Protein kinase B
AP-1	Activator protein 1
BAL	Bronchoalveolar lavage
BaP	Benzo[a]pyrene
BBB	Blood brain barrier

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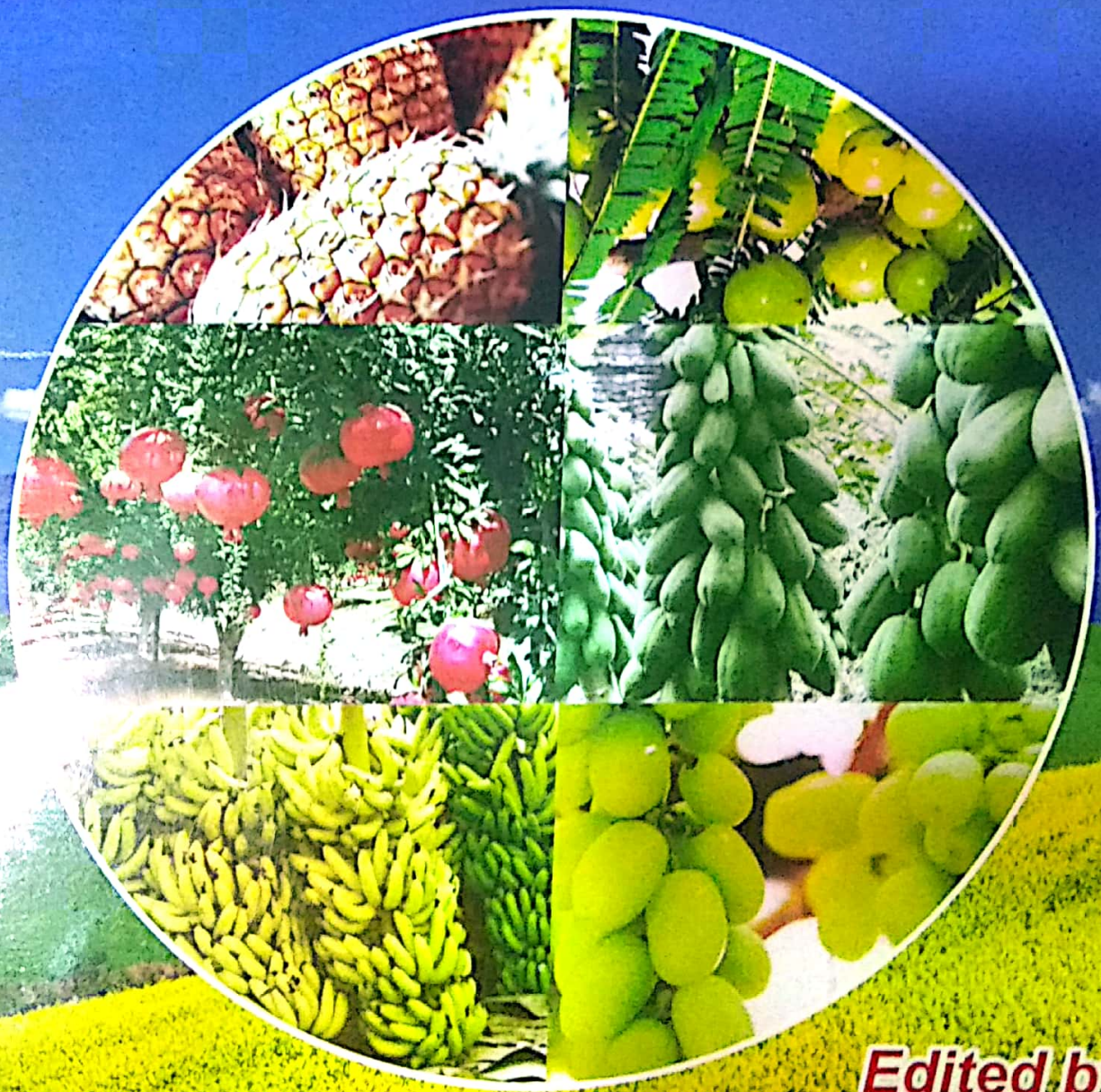

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Emerging Linkages Between Domestic Firms and Producers in Contract Farming of Vegetables in Punjab

PAVNEET KAUR AND NARESH SINGLA

Akal University, Talwandi Sabo, Bhatinda and Centre for Economic Studies, Central University, Bhatinda, Punjab

The linkages between domestic firms and the farmers are seen as one of the innovativeways in linking farmers with the markets in crises ridden agrarian economy of Punjab. However, in most of the cases globally, domestic firms are found to work with large farmers and exclude small farmers from the value chains due to various reasons. In this context, the study explores the contract farming linkages between the farmers and the firm in terms of procurement operations of the firm and its impact on returns, and crop diversification of the farmers with a survey of 50 eachsugarbeet growing contract and non-contract farmers growing other rabi crops (wheat). The results of the study reveal that the domestic firm procured sugar beet through the non-verbal, formaland non-registered contracts. Most of the farmers working with the firm were medium and large as compared with marginal, small and semi-medium among non-contract farmers. Since sugarbeet is grown as alternative with wheat crops, the cost and return analysis of sugarbeet vis-à-vis wheat shows, growing sugarbeet was more remunerative in comparison with wheat crop. The study has also revealed that the direct contract farming by the firm has also helped to shift their cropping pattern away from traditional wheat crop and provided more employment opportunities particularly for women. The study has proposed certain strategies to facilitate agrarian prosperity in the presence of contract farming.

1. INTRODUCTION:

Punjab's agrarian economy was acknowledged for its opulence since the introduction of green revolution, however in 1980s, agriculture sector started showing the signs of deceleration and stagnation in yield level of major crops. As the state agriculture moved towards specialization of wheat and paddy crop that has formed the serious concern for the sustainability of profitability in the long run and maintenance of eco-system. Thus, the policy makers and various studies recommended for the diversification towards fruits and vegetables (F&Vs) (Singh, 2004; Dhillon and Singh, 2006). It is argued that diversified agricultural economy is expected to enhance farm income and employment opportunities in rural economy. However, the traditional marketing of F&Vs is quite complex and risky phenomenon in India as there is long chain of intermediaries in the marketing that leads to very small fraction of every rupee of profit to the farmer. In this context, alternative institutional arrangements such as contract farming can play a vital role to minimize transaction costs related to uncertainty and market failures associated with high value crops. Contracting is perceived as the risk distribution measure between the farmer and the buyer, where farmer takes on the risk associated with agricultural production and buyer taking on the risk of marketing and distribution (Rangi and Sidhu, 2007; Singh, 2007). Thus, basic purpose of adoption of

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such a policy is to provide a proper linkage between the farm and the market by giving farmer an assured price and procuring the farm produce on the one hand and insuring timely and adequate input supply to the agro-based and food industry on the other.

It is also argued that linking farmers to contracting firms may also cause a shift in the cropping pattern toward high value crops and consequently, result in diversification away from traditional crops like wheat-paddy. Most of the earlier studies largely focused on single potato crop. Thus, an attempt has been made to explore the contract farming potential of the new crop introduced by new contract farming firm besides exploring diversification potential of the crop and role in employment generation which is not covered in the earlier studies at all. The second section discusses the implications of contract farming in context of existing literature. The third section enumerates the data sources and methodology used in the study. The subsequent section examines the provisions of contract, role of contract farming in diversification, farm returns and labour absorption. Finally, the study will examine equity implications of contract farming grounds as there have been no studies relating to this aspect in Punjab's agrarian economy.

2. ASSESSMENT OF CONTRACT FARMING IMPLICATIONS:

In Gautemala, ALCOSA operated 17 buying stations to procure cauliflower, broccoli and brussels. At buying stations, farmer themselves classify and pack their produce in baskets provided by the factory. After weighing the product, farmers get the delivery receipt (Glover and Kusterer, 1990). In Tropical Africa, Kawacom procured an organic coffee from farmers' at collection centre and pressing and grading is done in Kampala factory (Bolwig *et al.*, 2009). Vermeulen *et al.*, 2008 found that in South Africa, agri-business companies procured 78.5 per cent of the F&Vs for processing through contractual arrangement.

Contract farming had a positive effect on producers average return of corn and soybean in US (Hu, 2013), an organic coffee in Tropical Africa (Bolwig *et al.*, 2009), pollinated tomato seed in Rangpur (Sarkar *et al.*, 2011), sunflower in Tanzania (Henningsen *et al.*, 2015) and for seed corn and broiler in Indonesia (Simmons *et al.*, 2005), while it had insignificant effect on wheat producers in US and seed rice contract in Indonesia. The returns per acre of cropped area for all direct contracting firms (Pepsi, HLL, Chambal Agritech and AM Todd) were higher in case of direct contracted crops as compared to indirect contract crops of PAFC and non-contracted crops in Punjab (Kumar, 2006), higher returns from gherkin production in Andhra Pradesh as compared to other crops (Dev and Rao, 2005) and tomato in Punjab (Rangi and Sidhu, 2007). The mint contract growers of AM Todd & Co. in Punjab had lower cost of production; almost negligible transaction cost as the company did not charge for extraction of oil and higher net income than that of the non-contract growers (Singh, 2009).

Contract farming in case of tomato processing industry in Dominican Republic increased the demand for women's farm labour; along with self esteem and strengthens their domestic standings (Raynolds, 2002). In Peru, the cultivation of asparagus had doubled the burden of house and farm work on women. However, it had positive impact on women's net income (Glover and Kusterer, 1990). In contract farming, women had been mainly employed because of their feminine skills and nimble fingers to accomplish delicate work. However, these were based on social

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skills entrenched during the upbringing of girls instead of natural skills (Singh, 2003). Female young workers employed in cotton seed farms of Andhra Pradesh were unfree labour and such changes in gender relations put more of the family maintenance onus on the women and daughters (Venkateshwarlu and Corta, 2001). For cotton-seed production, 10 to 15 children were hired for 100 to 150 days. In case of scarce labour, children were being ``tied" to contract farmers with advances of cash and grain to parents. Many girls also came with their mothers to fields for casual work (Ramamurthy, 2000).

3. METHODOLOGY:

Rana Sugars Limited involved in direct procurement and processing of sugarbeet was selected for the study. Tarn Taran and Amritsar districts were identified on the basis of maximum area under the contract with firm. A sample of 50 farmers under contract with firm was taken through the stratified random sampling and another sample of 50 wheat farmers in the vicinity of Rana Sugars Limited selling in the traditional market was also taken based on the proportion of farmers in each category in district through the stratified random sampling technique.

Simpson Index of Diversification (SID):

Horizontal diversification is the increase in number of crops grown in order to either increase or stabilize their income. To assess the impact of cropping pattern Simpson index is used to measure the extent of diversification.

Where, i= 1, 2,.....n

P_i = proportionate area of traditional (wheat-paddy) crop in the gross cropped area

SI is bound by 0 and 1 with 0 implying complete specialization and 1 implying complete diversification.

Garrett's Ranking Technique

The problems of involvement in contract scheme were prioritised using Henry Garrett Ranking Technique. As per this method, farmers have to assign the rank to major issues of dissatisfaction and the outcome of such ranking has been converted into score value with the help of the following formula:

Where

R_{ij} = Rank given for the i^{th} variable by j^{th} farmers

N_j = Number of variable ranked by j^{th} farmers

4. RESULTS AND DISCUSSION:

The farmer category-wise analysis shows that 54 per cent of the medium farmers worked with contract firm followed by 22 per cent large farmers and 18 per cent semi-medium farmers. However, only 6 per cent small farmers were involved in sugarbeet contract crop. Furthermore, not even a single farmer from marginal land holding size category was involved in contract farming. However, 36 per cent of the non-contract farmers in the vicinity of contract farmers belonged to semi-medium category followed by 28 per cent in medium, 20 per cent in small and 8 per cent each to small and large farmer categories. The average operational land holding size was much higher in case of contract farmers (24.36 acres) as compared to 11.9 acres in case of non-contract farmers (Table 1).

Rana Sugars Limited had 3000 contract farmers under sugarbeet with around 9000 acres through formal, non-registered contract. The firm claimed to have a written contract and a copy of the same was provided to the farmers. But, only 72 per cent of the farmers conceded for the written contract, while only 6 per cent actually possessed the copy of the

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Table 1

Distribution of Sampled Farmers by Different Operational Land Size

Crop		Marginal (less than 2.5 acres)	Small (2.5-5 acres)	Semi-medium (5-10 acres)	Medium (10-25 acres)	Large (greater than 25 acres)	Overall
Sugarbeet	Farmer (%)	-	6	18	54	22	100
	Area (acres)	-	4	8.05	17.8	59.3	24.36
Wheat	Farmer (%)	8	20	36	28	34	100
	Area (acres)	2.3	4.3	8.8	16.9	37.7	11.9

contract. Some of the farmers pointed out that they trusted the firm and did not feel the need for copy of the agreement. It was observed during field survey that the farmers were not sure about the number of parties involved in the agreement. As many as 76 per cent of the farmers enlightened that only two parties i.e. farmer and firm signed the agreement, while another 24 per cent pointed out the involvement of three parties (farmer, firm and bank). 76 per cent of the contract farmers were able to avail the credit facility from IDBI bank as the company itself acted as guarantor (Table 2). The IDBI provided a loan of Rs. 20,000 for an acre. The maximum limit of providing loan to each farmer was Rs. 1 lakh for 5 acres. However during field survey, it also came to light that some of the large farmers were registered for the crop with the firm in the name of 3-4 family members. Seed was provided by the firm at 80 per cent subsidized rates to the farmers, costing about Rs. 1000/ acre to each farmer as against Rs. 5000/acre. During 2014-15 crop season, payments of the farmers were delayed for 3-4 months. As a result large number of farmers did not want to grow sugarbeet during next sowing season. Therefore, the firm started loan facility to the farmers through IDBI bank. But, 50 per cent of the farmers considered availing of credit as half of the advance payment for the produce from the company. Thus, these farmers were of the view that even if the company did not procure their crop, they were on the safe side. However, other farmers said those had taken loan were not aware about 12 per cent interest charged on the loan availed. On transportation cost, the firm conceded that gate area farmers themselves had to bear the cost, but in context of the farmers outside gate area, the firm bore it. As the firm provided Rs. 10 more than the fixed price for produce as transport charges to those farmers, who supplied over a distance of 20 km, while for those who brought it from more than 100 km, the firm arranged truck facility and transport cost was equally borne by both the parties.

The firm started the sugarbeet harvesting from 27 April, 2016 and sent its own harvester to the field on the sequence basis of sowing dates. Pulling, topping and loading work were done with harvester. 8 per cent of the contract farmers did harvesting manually. The reason behind it was that during the peak season of crop harvesting due to heavy workload,

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Table 2

Firm and Farmers Responses on Various Contract Provisions

Contract terms		Firm Yes	Farmers' responses	
			No	
Written contract		Yes	36 (72)	14 (28)
Language		Punjabi	36 (72)	-
Copy provided		Yes	3 (6)	47 (94)
Credit facility	Provided	IDBI	50 (100)	-
	Taken		38 (76)	12 (24)
Transport cost	For produce	Farmer/firm	24 (48)	26 (52)
	For seed	Farmer	50 (100)	-
Weather insurance	Provided	No	-	-

Note: Figures in parentheses are percentage to total contract farmers.

the firm's harvester sometimes delayed the harvesting work and even one of the farmers revealed that deduction rate was less on the produce harvested manually due to less quantity of leaves and mud. However, with harvester also the cost remained almost same as the harvester spreads the beets in the field, so to collect those beets from field and loads it into trucks or trolleys labour was required.

4.1 Economics of sugarbeet and wheat production:

Costs and returns are expected to be diverse across crops and regions. Various studies affirmed high cost of production for the contract crops, so the farmers will likely to indulge in contract farming only if they will get high net returns. The costs and returns for both the crops are examined to check viability of contract crop. Table 3 shows higher costs of production for sugarbeet contract crop than non-contracted wheat crop. The total cost of production C for sugarbeet crop was Rs. 38,371 per acre and for wheat crop, it was Rs. 20718 per acre. The major cost components among contract and non-contract farmers were machine labour, fertilizer, weeding (only in case of sugarbeet crop) and harvesting. The contract farmers spent about 17 per cent of the total cost only on weeding.

In sugarbeet, transportation cost was Rs. 1866 per acre, while loading/unloading charges accounted for Rs. 530 per acre. The non-contract farmers had to spend Rs. 483 per acre as transportation cost, Rs. 127.64 per acre as cleaning and Rs. 70.26 per acre as loading and unloading charges (Table 4). The transportation cost was higher among contract farmers as they had to deliver their produce at the firm but on the other hand, non-contract farmers sold their produce in their own village or nearby villages' focal point.

The average yield in sugarbeet was 304.2 quintal/acre and in wheat, it was 17.18 quintal/acre. The contract farmers sold their entire produce to the company. However, non-contract farmers sold 86.7 per cent of the wheat produce and the remaining was stored for domestic use and seed. The average price was Rs. 167.6 per quintal and gross return per acre was turned out to be Rs. 50,967.4

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Table 3

Production Costs among Contract and Non-contract Farmers

Cost component (Rs./acre)	Sugarbeet	Wheat
Machine labour	1998 (5.21)	1752 (8.46)
Seed	1000 (2.61)	1237 (5.97)
Rowing	485 (1.26)	-
Manure	278 (0.72)	130 (0.63)
Fertilizer	3263.6 (8.50)	2065.2 (9.97)
Plant protection	1413 (3.68)	958 (4.62)
Weeding	6592 (17.18)	99 (0.48)
Hired labour	904 (2.35)	753 (3.63)
Irrigation	445 (1.16)	22 (0.11)
Digging-up/Harvesting	4580 (11.94)	1156 (5.58)
Depreciation on farm implements	345.2 (0.90)	308.2 (1.49)
Interest on working capital	628.7 (1.64)	245.2
Cost A1	21932.5	8725.6
Cost A2	36132.5	19885.6
Cost B	37593	20124
Cost C	38371	20718

Note: Figures in parentheses are percentages to the total cost C

Table 4

Marketing Costs among Contract and Non-contract farmers

Components	Sugarbeet	Wheat
Transportation cost	1866 (6.13)	483 (28.11)
Loading and unloading charges	530 (1.74)	70.26 (4.1)
Cleaning	-	127.64 (7.43)
Marketing cost	2396	680.9

Note: Figures in parentheses indicate the marketing cost in Rs./quintal.

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among contract farmers. The average price for non-contracted wheat crop was Rs. 1550 per quintal and gross return was worked out to be Rs. 26,629 per acre. The net return in case of contract farmers was Rs. 10,200/acre as compared to Rs. 5,230/acre in case of non-contract farmers. Therefore, sugarbeet was found to be more remunerative *rabi* crop as compared to wheat crop (Table 5). The study by Pathak *et al.* (2014) also concluded that the sugarbeet crop is more profitable than other *rabi* crops such as wheat and mustard.

Table 5
Returns of Contract and Non-contract Farmers

Farmers>	Sugarbeet	Wheat
Yield (quintal./ acre)	304.2	17.18
Sold (%)	100	86.7
Quantity sold (quintal)	304.2	14.9
Price (Rs./ quintal)	167.6	1550
Gross return (Rs./acre)	50967.4	26629
Production cost (Rs./ acre)	38371	20718
Marketing cost (Rs./acre)	2396	680.9
Total cost (Rs./acre)	40767	21398.9
Net returns (Rs./acre)	10200.4	5230.1

4.2 Crop Diversification and Labour Employment:

The SID has been calculated for both contract and non-contract farmers. The diversification was observed to be relatively more in case of contract farmers than non-contract farmers. The index value was turned out to be 0.33 in case of contract farmers as compared to 0.11 in case of non-contract farmers. Thevalue of SID was highest in medium contract farmers (0.34) followed by large and semi-medium farmers (0.33 each) and small farmers (0.25) (Table 6). Among contract farmers, diversification away from traditional wheat-paddy crop was mainly towards cultivation of sugarbeet, sugarcane, carom, moong and vegetables like tomato, peas, cauliflower, etc. In case of non-contract farmers, crop diversification away from traditional crops was lesser than contract farmers across all the farm size categories. Among large non-contract farmers, some diversification towards cultivation of potato and peas was observed. However, in case of semi-medium non-contract farmers, there was no sign of crop diversification away from traditional crops as about 98.8 per cent of the GCA was found to be under wheat-paddy crop.

The share of agricultural labourers and cultivators to total workers in Punjab was 35.94 per cent in 2011 (GoI, 2011). Vegetables require more rigorous farm workers as compared to other crops. In literature of contract farming, the possibility of employment generation with contract crops was hypothesized due to labour intensive nature of crop production under contract and for post harvest operations such as sorting, grading, packing, etc. (Glover, 1994; Glover and Kusterer, 1990; Singh, 2005). Manual labour is necessary in sugarbeet cultivation for distinct operations such as cultivating, weeding, blocking, thinning and topping. 26.7 man days per acre were required for the sugarbeet crop season. Around 65 per cent of the total labour was required only for manual weeding operations. More female workers were preferred by the farmers to reduce their cost of cultivation. The female worker is

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Table 6

Simpson's Index of Diversification among Contract and Non-contract Farmers

Farm size categories	Contract farmers	Non-contract farmers
Marginal	-	0.10
Small	0.25	0.14
Semi-medium	0.33	0.01
Medium	0.34	0.06
Large	0.33	0.24
All	0.33	0.11

also known for superior quality work due to their seriousness. While in case of traditional wheat crop only 6.58 man days per acre were obligatory. No female worker was involved in the cultivation process of wheat (Table 7). In Punjab, female workers were found mainly in picking works of cotton, F&Vs and also in grading related works.

4.3 Production and marketing problems faced by farmers:

During cultivation of sugarbeet, the farmers faced several problems like shortage of labour, high cost of inputs, weed and pest problem in the crop. Shortage of labour was ranked first. Due to emergence of weeds in the crop, more labour was required for weeding operations. During harvesting period, the summer starts, so the workers were not easily convinced for going to field. Emergence of weeds in sugarbeet was the second major problem with 49.42 mean score. As the sugarbeet is crop of short height and many weeds grow taller than the sugarbeet plant, thereby resulting in greater yield losses. High cost of inputs was the third major issue with 48.02 mean score. Increased price of inputs like chemical kit and high labour consumption for hand weeding and harvesting along with

Table 7

Average utilization of Labour in Farm Operations

Farm operation (man-days per acre)	Contract farmers		Non-contract farmers
Land preparation	1.56		1.15
Sowing and rowing	1.12		0.83
Blocking and thinning	1.00		-
Application of fertilizer	1.07		1.17
Application of pesticide	0.98		1.12
Irrigation	1.08		0.98
Weeding	17.38	Male- 11.16	-
		Female- 6.02	
Harvesting	2.21		1.33
Total	26.4		6.58

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increased wages has escalated the cost of production (Table 8).

Table 8

Henry Garrett Ranking of Contract Farmers for the Production Problems

Production problems	Average score	Rank
Shortage of labour	65.2	1
High cost of input	48.06	3
Emergence of weeds	49.42	2
Pest attack	37.32	4

On thecontract farms, low price with a Garrett score of 70.46 was the major marketing constraint. Late payments were the second major issue among the farmers. During 2014-15, losses for the sugar industry had mounted to an all-time high as sugar prices were perched around six-year low. Thus, the contract firm also failed to make timely payments to sugarbeet farmers. The third issue was high marketing cost (54.52 score) followed by high deduction rate (53.34 score). The fifth problem was transport difficulties with a mean score 45.94. During field survey, the farmers enlightened that for transporting one acre produce, three trolleys were required. Since one trolley has a capacity of 100-120 quintal sugarbeet crop, when the farmers deliver the produce at company, the labour remain idle in the field. Thus, it escalated the marketing cost for the farmer. Thus, hiring of more trolleys becomes essential for the contract farmers. Next constraint faced was distance of the firm from the farmers' field with 43.52 score. As the crop deteriorates fast after harvesting and have to be supplied to the firm preferably within 24 hours of harvesting. Storage is not possible even for a few hours. The firm would like to spread delivery of produce over the longer period on the basis of raw material requirement (Table 9). This causes a backlog at the delivery point and quite often quantity deteriorates due to shrinkage resulting in the loss of the quantity premium. Therefore, a well coordinated plan of harvesting and supplying of produce is of utmost importance for the farmers and firm.

Table 9

Henry Garrett Ranking of Contract Farmers for the Marketing Problems

Marketing problems	Average score	Rank
Low price	70.46	1
Late payment	64.98	2
High marketing cost	54.52	3
Distant market	43.52	6
High deduction rate	53.34	4
Transport difficulties	45.94	5
Weight loss of beets	40.1	7
Default in procurement	37.94	8

5. CONCLUSION:

Punjab agriculture moved towards specialization of wheat and paddy crop after the introduction of green revolution that has formed the serious concern for the sustainability of profitability in the long run and maintenance of eco-system. Thus, it is argued that diversified agricultural economy is expected to enhance farm income and reduces the risks of the farmers. Rana Sugars Limited procured the entire produce of the contracted crops at the pre-fixed prices. In present case study, remuneration from sugarbeet crop was attractive enough that the farmers can move away from traditional wheat cultivation. The firm was ready to work even on one acre land but some of the small and marginal farmers themselves did not feel confident for entering in contract with private firms as

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they felt risky about them as there was no role of any government agencies in contract practices.The major suggestions to facilitate agrarian transformation in the presence of the contract farming is inclusion of small and marginal farmers through active role of public agencies, registration of contract so that the firms can't exploit farmers such as in the form of delayed payments, setting up of more such agri-business firms on the basis of region specific crops in other districts of the state to bring diversification and increase bargaining power of the farmers.

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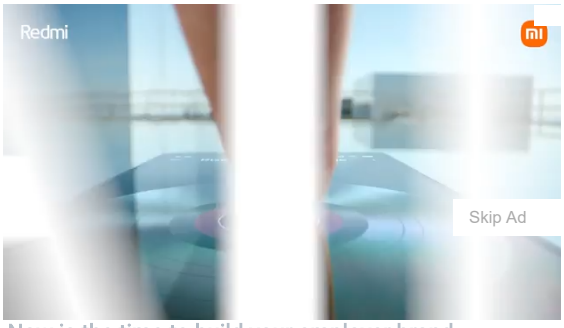

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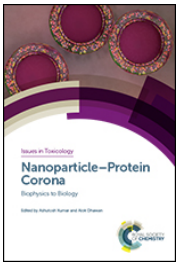

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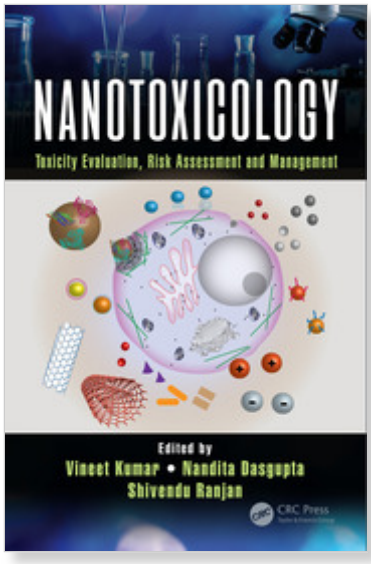

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Chapter 4

Use of Agricultural Solid Wastes as Adsorbents

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Abstract

Biosorption through agricultural lignocellulosic wastes and by-products has been identified as a viable substitute to current technologies applied to remove toxic metal ion and organic pollutants from water and wastewater. The present study emphasizes the use of agricultural and agro-industries based residues as low-cost biosorbents. The study aims to revisit the status of biosorption and various recent advances made in this arena. Biomasses are the main focuse of this study which requires substantial management. Further, this is supplemented with the physicochemical processing of such biomasses and their application in adsorption. The surge in biomass to energy applications in recent years has resulted in charred biomass production as a residual. These biochars have been used as adsorbents. The biosorbents have been divided into the following three groups: (i) raw biomass, (ii) processed biomass and (iii) charred biomass. The affinity of sorbents in the removal of organic and inorganic pollutants and their applications on water and wastewater have also been studied.

Keywords

Agricultural Waste, Heavy Metals, Organic Contaminants, Biomass, Biochar

Contents

1. Introduction

Agriculture and akin sectors are pivotal to sustainable growth and development. Agriculture derives its prominence from the fact that it has vital supply and demand links with the manufacturing sector. During the past few decades, the production and productivity of food grains, commercial crops, oilseeds, fruits, and vegetables in India have witnessed remarkable growth [1]. The Indian economy is driven by the agricultural sector and since independence, an exponential growth has been encouraged in this particular sector. It has been primarily an outcome of multi-pronged, government-driven program known as 'Green Revolution' which aimed at ensuring availability and use of quality seeds, irrigation facilities, chemical fertilizers, pesticides, farm machinery, equipment, etc.

With the onset of the green revolution, the surplus crop residue generation increased proportionally in developing and developed countries. About 4000 Mt/yr crop residue is produced worldwide from food crops [2]. The widely available agricultural residue is one of the most abundant renewable resources in the world. About 25% of nitrogen, 25% phosphorus, 50% of sulfur and 75% of potassium uptake by cereal crops are retained in residues, thus serving as valuable sources of nutrients. These residues have little or no economic value and often create a disposal problem. Globally, open agricultural residue burning is practiced for farm management, resulting in the emission of particulate matter, polycyclic aromatic hydrocarbons (PAH), soot and greenhouse gasses [3,4]. A Large proportion of the residues, about 140 Mt, is burned in open fields, to immediately clear straw after harvest of the previous crop [5]. Typically, the residue is burnt for rice, wheat, maize, sugarcane, cotton, jute, millet, rapeseed, and groundnut crops. Several endeavors have been started for the proper utilization of the waste viz: composting of residues for

manure, farmyard manure (FYM), energy from waste, bioethanol, biomethanation, gasification of residues and pyrolysis to produce biochar [6,7]. Particularly, biochar technology is investigated for its carbon sequestration characteristics and is suitable for multifaceted applications in conservation agriculture [2,8] to combat the climate change scenario. Alternatively, biomass, its composites, and biochar have been studied for the biosorption of various organic and inorganic pollutants in water and wastewater treatment [9,10,11].

Biomass-based biosorption is one of the prominent processes for removal of organic and inorganic pollutants from water and wastewater at lower concentrations. In the recent past, several studies have been carried out, where the plant materials constituting lignocellulosic content have proven efficient and effective biosorbents for heavy metal ion removal. Heavy metals are hazardous for the environment and humans due to their toxic nature and non-biodegradability [12,13]. Both natural and anthropogenic sources contribute to heavy metals present in the environment. Natural sources are generally geogenic in origin. Volcanic eruptions, weathering of rocks, and leaching to water bodies act as a mode of entry of these contaminants to air, water and soil. Anthropogenic sources can be classified as industrial, agricultural, domestic effluents, mining, motor vehicle emissions etc. many of the inorganic pollutants remain unaffected by water and wastewater treatment processes because of their conservative nature. These include heavy metals from metal finishing and plating operations, and other industrial discharges [14]. Heavy metals are regarded as trace elements, whose bioavailability is influenced by many physical, chemical and biological factors. Toxicity of non-essential metals like Hg(I, II), Cd(II) and Pb(II) etc. mainly occurs through displacement of trace metals from their binding sites or through ligand interactions [15,16]. Long-term exposure to these metals may lead to carcinogenicity (through arsenic); dysfunctional nervous system (through mercury); hypertension and heart ailments (through cadmium); and interference with hemoglobin formation (through lead). Organic contaminants can be broadly classified as pesticides, dyes, antibiotics and polycyclic aromatic hydrocarbons (PAH). These contaminants originate from industries, agriculture, landfills, household wastes and through accidental leakage or spills leading to their entry in environmental matrices. Such contaminants can pose danger to living organisms by entering into the food chain. Therefore, there is a need to adopt proper disposal methods or treatment technologies to remove these harmful chemicals from the environment.

Several methods have been adopted to treat water and wastewater, which include biological, chemical and physical techniques. In the past few decades, the commonly used techniques are ion-exchange [17], electrolysis [18], flotation [19], membrane filtration [20], coagulation [21] and adsorption [22]. Treatment technologies available for

removal of organic contaminants include ultrasound combined with photo-Fenton treatment [23], advanced oxidation processes [24], ozonation [25], electrodialysis membranes [26] etc. However, these methods have several shortcomings such as high operational and maintenance costs, generation of secondary pollutants etc. Compared to all these treatment techniques, adsorption has emerged to be an effective approach for the abatement of water and soil organic contaminants. The most commonly used adsorbent is activated carbon, which is used for removal of a variety of organics broadly classified as pesticides, dyes, drugs, pharmaceutical products, polycyclic aromatic hydrocarbons (PAH) etc. However, concerns related to its use include higher costs, regeneration capacity, and disposal.

Agro-wastes are energy efficient, low cost and effective substitute for activated carbon as an adsorbent. Agricultural wastes are lignocellulosic rich in organic content and contain many functional groups which help in binding the contaminants on the adsorbent surface. The basic components of the agricultural waste biomass include cellulose, hemicellulose, lignin, lipids, proteins, sugars, starch, polysaccharides, and pigments. These constituents have varied functional groups on their surface. In the present chapter, the physicochemical adsorption mechanism of the biomass, chemically modified biomass and thermochemical treated biomass has been explored for the removal of organic and inorganic pollutants.

1.1. Use of raw biomass as biosorbents

Agricultural based plant adsorbents are abundant, economical, and renewable and are mainly composed of cellulose and lignin, hence making them a viable option for wastewater treatment. The presence of structural-functional groups plays important role in efficacy of the biosorbents [27,28]. In the last few decades various researchers have explored the efficacy of agricultural wastes as biosorbents viz: husk [29,30], stalk [31,32], bagasse [33,34], shell [35,36] and straw etc. [37,38].

Table 1 Adsorption behavior and efficiency of raw biomass for heavy metal pollutants.

S.No.	Agricultural Waste	Heavy metal	Adsorbent dose (g/L)	pH	Reaction time (min)	Amount adsorbed ($q_{e)}$ (mg/g)	Ref.
1.	Rice straw	Cd(II)	-	2-6	180	13.84	[39]
2.	Barley straw	Cu(II)	1	6-7	120	4.64	[37]
3.	Cashew nut shell straw	Ni(II)	3	5	30	18.86	[35]
4.	Rice shell	Cu(II)	10	6	180	2.95	[40]
5.	Wheat shell	Cu(II)	10	6	180	17.42	[40]
6.	Lentil shell	Cu(II)	10	6	180	9.59	[40]
7.	Wheat stem	Cd(II)	-	5	60	11.2	[41]
8.	Wheat bran	Cr(VI)	20	-	-	0.942	[42]
9.	*Picea smithiana*	Cr(VI)	2.0	4.5	1440	228	[43]
10.	*Pinus sylvestris*	Cr(VI)	1	7	120	0.201	[44]
11.	Sugarcane bagasse	Hg(II)	5	4	60	35.71	[45]
12.	Agave bagasse raw	Pb(II)	2	5	-	35.60	[34]
13.	Agave bagasse raw	Zn(II)	2	5	-	7.84	[34]
14.	Olive stone	Cu(II)	-	5.5-6	60	2.02	[46]
15.	Olive stone	Pb(II)	-	5.5-6	60	9.261	[46]
16.	Olive stone	Ni(II)	-	5.5-6	60	2.13	[46]
17.	Olive stone	Cd(II)	-	5.5-6	60	7.733	[46]
18.	Egyptian mandarin peel	Hg(II)	5	6.02	1440	19.01	[47]
19.	Sunflower hull	Cu(II)	2	5	180	57.14	[48]

Table 2 Agricultural wastes as adsorbent for organic pollutants.

S. No.	Agro-waste	Organic contaminant	Particle size	Adsorption conditions	Adsorbent dose (g/L)	Amount adsorbed(q_e) (mg/g)	Ref.
1.	*Phaseolus vulgaris* biomass	Reactive Red 198	<300µm	pH=2 Contact time=20min at 20°C	1.6	80	[49]
2.	Rice husk ash	2, 4-Dichlorophenoxyacetic acid	-	Contact time=12h at 30°C	0.1	1.425	[50]
3.	Pine leaves	Acid yellow 220 dye	63–500 µm	pH=2 Contact time=90 min	1	32.26	[51]
4.	Coir pith	Crystal violet	600 µm	300K	0.1	65.53	[52]
5.	Coir pith	Rhodamine B (RB)	600 µm	300K	0.1	55.54	[52]
6.	Sugarcane fiber	Crystal violet	600 µm	300K	0.1	10.44	[52]
7.	Sugarcane fiber	rhodamine B (RB	600 µm	300K	0.1	15.98	[52]
8.	Sugar beet pulp	Safranin	-	pH=10 Contact time=240 min	8	147.00	[53]
9.	Sugar beet pulp	Methylene blue	-	pH=10 Contact time=240 min	8	211	[53]
10.	Sunflower seed shells	Trifluralin	-	298K	12	2.29×10^{-2}	[54]
11.	Sugarcane bagasse	Indosol turquoise FBL dye	300 µm	pH=3 Contact time=30 min	1	22.72	[55]

12.	*Citrus sinensis*	Reactive yellow 42	<0.25	Contact time= 60min	20	13.99	[56]
13.	*Citrus sinensis*	Reactive red 45	<0.25	Contact time= 60min	20	15.21	[56]
14.	*Citrus sinensis*	Reactive blue 19	<0.25	Contact time= 60min	20	14.80	[56]
15.	*Citrus sinensis*	Reactive blue 49	<0.25	Contact time= 60min	20	27.41	[56]

1.2 Mechanism of biosorption

Biosorption is a multifaceted process affected by several factors. Mechanisms involved in the biosorption process includes chemisorption, microprecipitation, ion-exchange, complexation, adsorption–complexation on surface and pores, heavy metal hydroxide condensation onto the surface and surface adsorption [57]. Functional groups present on the surface of adsorbent play a pivotal role in immobilizing the metal adsorbed onto biomass material. Plant cell walls are the sites where all the functional groups are present which are helpful in the binding process, cell walls are generally composed of cellulose molecules, organized in microfibrils, surrounded with hemicellulose (glucomannans, mannans, galactans, arabinogalactans, xylans), lignin and pectin [58]. The arrangement of cellulose, hemicelluloses, and lignin is depicted in Fig. 1. The inner core is made of crystalline cellulose, stacked one above another by interlayer hydrogen bonding with few of the sections carrying amorphous cellulose [59]. These amorphous regions are better known for the adsorption of heavy metals based on the available functional groups. The cellulose layers are intertwined with the amorphous hemicellulose followed by the covalent binding with lignin in the shell surface. Lignin is a polyphenolic polymer comprising of three main phenol derivatives namely, coniferyl alcohol, coumaryl alcohol and sinapyl alcohol. These three components primarily have hydroxyl and carboxyl components, which are responsible for heavy metals sorption, whereas the crystalline structure with hydrophobic pores is essentially responsible for the adsorption of various organic adsorbates. Thus, the behavior of the substrate is highly dependent upon the porosity, crystallinity, surface area and degree of polymerization of fibers. The additional features of high ash content i.e. silica, N, P, K etc. in the crop residues result in enhancing adsorption behavior of the crop residues vis-a-vis the woody biomass [60].

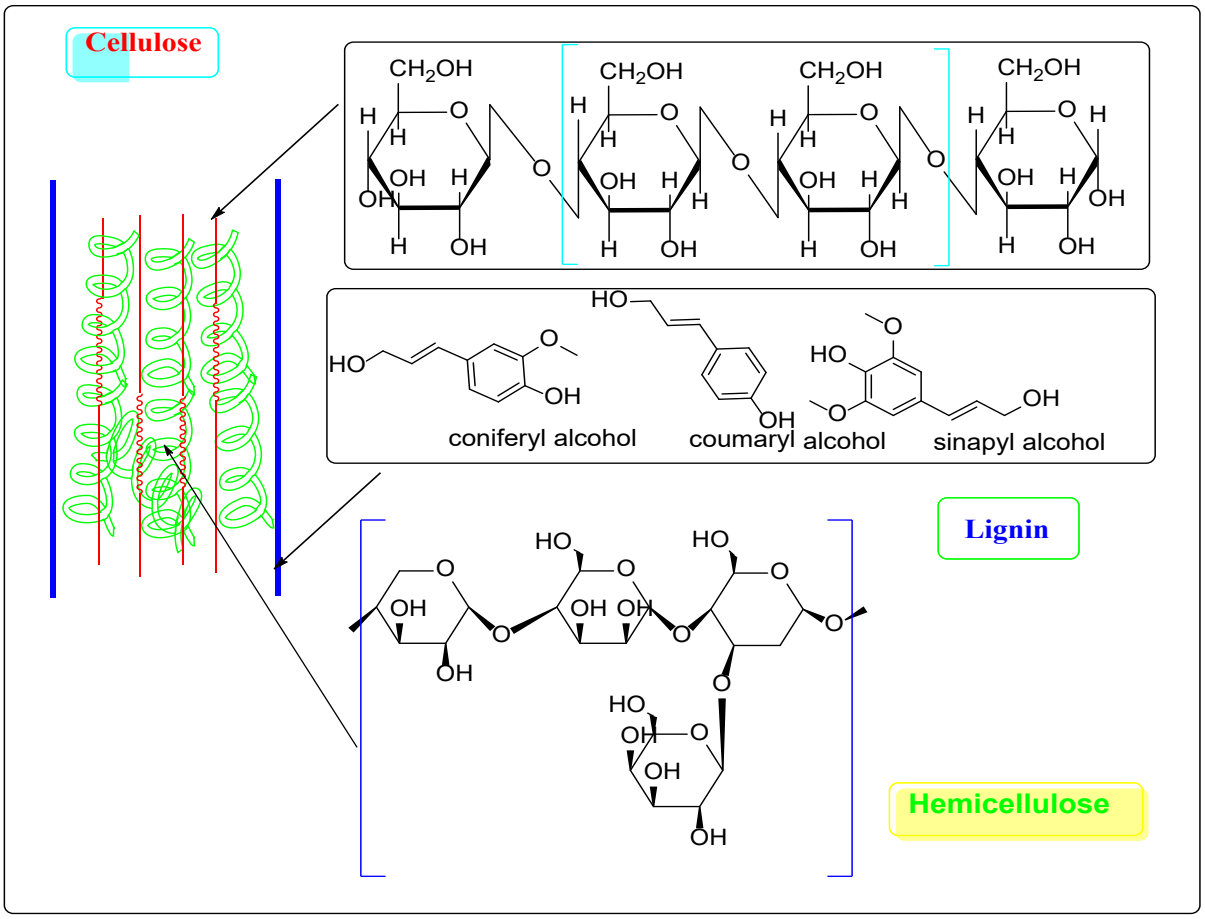

Figure 1 Lignocellulosic biomass compositions, structural arrangement and chemical characteristics of the components of biomass [2].

Laszlo and Dintzis, [61] have shown that lignocellulosic have sorption capacity. Lignocellulosic are hygroscopic in nature, where water permeates the non-crystalline portion of cellulose, hemicellulose, and lignin. Cellulose can thus adsorb heavy metals from a solution [62]. The molecular structure and supramolecular structure of cellulose have a strong influence on sorption properties. Adsorption of an aqueous solution by fibersresult in cellulose swelling. The more it swells, the higher is the amount of adsorption. Swelling also depends on the fibre structure, degree of crystallinity or amorphous and void regions [63].

2. Physicochemically treated biomass and their adsorption characteristics

As discussed earlier, agricultural solid waste materials are available in abundance and can be used as biosorbents due to their physicochemical characteristics. The utilization of agricultural solid wastes is of countless significance and can play a vital role in the national economy [63]. The major constituents of agricultural waste are lignin, hemicellulose, and cellulose that contain several functional groups such as aldehydes, alcohols, carboxylic acid, ketones, phenolic and ether linkages. These groups have resilient ability to bind with toxic metal ions by utilizing an electron pair to form different complexes in solution [64]. Recently, Zafar et al. [65] modified rice bran through various chemicals and utilized for the adsorption of nickel ions. Similarly, various results (Table 3) focus on using treated biomass for contaminant removal.

Table 3 Physicochemically processed agricultural residual biomass and their adsorption efficiency for metal ions.

S.No.	Agri waste	Heavy metal	Adsorbent dose (g/L)	pH	Reaction time (min)	Amount adsorbed (q_e) (mg/g)	Ref.
1.	Barley straw citric acid	Cu(II)	1	6-7	120	31.71	[37]
2.	Grapefruit $ZnCl_2$	Pb(II)	10	5.3-6.5	90	12.73	[66]
3.	Agave bagasse HCl	Cd(II)	1	5	-	12.50	[34]
4.	Agave bagasse HCl	Pb(II)	1	5	-	42.31	[34]
5.	Agave bagasse HCl	Zn(II)	1	5	-	12.40	[34]
6.	Agave bagasse HNO_3	Cd(II)	1	5	-	13.50	[34]
7.	Agave bagasse HNO_3	Pb(II)	1	5	-	54.29	[34]
8.	Agave bagasse HNO_3	Zn(II)	1	5	-	14.43	[34]
9.	Agave bagasse	Cd(II)	1	5	-	18.32	[34]

	NaOH						
10.	Agave bagasse NaOH	Pb(II)	1	5	-	50.12	[34]
11.	Agave bagasse NaOH	Zn(II)	1	5	-	20.54	[34]
12.	Orange peel citric acid	Cd(II)	4.3	6	120	0.90	[67]
13.	Egyptian mandarin peel NaOH	Hg(II)	5	6.02	1440	23.26	[68]
14.	Orange peel KCl	Cu(II)	5	5-5.5	120	59.77	[44]
15.	Orange peel KCl	Cd(II)	5	5-5.5	120	125.63	[44]
16.	Orange peel KCl	Pb(II)	5	5-5.5	120	142.94	[44]
17.	Orange peel KCl	Zn(II)	5	5-5.5	120	45.29	[44]
18.	Orange peel KCl	Ni(II)	5	5-5.5	120	49.14	[44]
19.	Orange peel K^+	Cu(II)	5	5-5.5	120	59.77	[69]
20.	Orange peel Mg^{2+}	Cu(II)	5	5-5.5	120	40.37	[69]
21.	Orange peel sulfured	Pb(II)	5	5	-	164.0	[70]
22.	Orange peel sulfured	Zn(II)	5	5	-	80.0	[70]

Various studies have reported the effect of pre-treatment on raw agricultural wastes (Table 4). Sadaf et al. [55] investigated the effect of chemical (acids, chelating agents, and organic solvents) and physical treatment (autoclaving and boiling) on sorption capacity of sugarcane bagasse and reported an increase in sorption capacity by these treatments. Treatment with HCl achieved the highest increase in the investigations. Increase in porosity, and high surface area, resulting in the availability of more active sites was the reason for higher sorption capacity.

Table 4 Physicochemically treated agricultural residual biomass and their adsorption characteristics for organic pollutants.

S. No.	Agricultural waste biomass	Organic contaminant	Particle size	Kinetic conditions	Loading (g/L)	Amount Adsorbed (mg/g)	Ref.
1.	Rice husk Mechanical	2, 4-Dicholorophenoxyacetic acid	42.1 nm	pH=5 60min	1.5	76.92	[71]
2.	Rice hull Tartaric acid	Methylene blue	-	300min	5	25	[72]
3.	Sugarcane bagasse HCl	Indosol turquoise FBL dye	300 µm	pH=3 30 min	1	27.17	[55]
4.	Sugarcane bagasse Na-alginate-immobilized forms	Indosol turquoise FBL dye	300 µm	pH=3 1h	1	10.54	[55]
5.	Cotton stalks NaOH	Methylene blue	-	1440 min	2	-	[73]
6.	Palm shells H_2SO_4	Chloropyriphos	-	pH=6 240 min	-	52.63	[74]
7.	Palm shells H_2SO_4	Monocrotophos	-	pH=6 240 min	-	51.099	[74]
8.	*Citrus sinensis* Acetic acid	Reactive yellow 42	<0.25 mm	60 min	2	17.64	[56]
9.	*Citrus sinensis* Acetic acid	Reactive blue 19	<0.25 mm	60 min	2	23.31	[56]
10.	*Citrus sinensis* Acetic acid	Reactive blue 49	<0.25 mm	60 min	2	33.53	[56]

3. Use of charred biomass

While many adsorbents derived from agro-waste are widely available, but their adsorption capacity is low when compared with the processed forms. Many researchers have reported enhanced activity of pyrolyzed waste or activated char compared with the parent material in the raw form [75]. Biochar is gaining attention for its use as an adsorbent to remove organic compounds from water and soil environments. It's used as adsorbents environmental friendly, renewable and generates minimum waste production besides supporting, regeneration of adsorbent. Biochar is a solid material obtained from thermochemical conversion of biomass in an oxygen-limited environment. It is a source of renewable energy with the high potential to aid in environmental management. Biochar considered a form of black carbon is stable, recalcitrant organic, and produced from a variety of waste biomass materials such as crop residues, wood waste, garden waste, municipal solid waste, animal manure and food waste etc. under temperature and oxygen controlled conditions [76]. It has varied functional groups on its surface (Fig. 2). Slow pyrolysis leads to the generation of biochar and gas as major products. The key application of biochar is in sequestration of carbon and hence combating climate change. Beside this, when added to soil, biochar also acts as a soil conditioner which helps in holding carbon, improving microbial activity, increasing soil biodiversity by replenishing nutrient in deficient soil and thus enhance crop yield and food security. Biochar also helps in retaining nutrients and agrochemicals for a plant, hence resulting in reduced run-off and leaching into the underlying water. Due to all these functions, it has emerged as a very effective tool for environmental management [76]. Biochar was primarily introduced as a soil amendment, but the recent research has highlighted its ability to immobilize various organic contaminants in soil [75,77,78]. Biochar is known to enhance the sorption as well as the bioavailability of pesticide residues for biota. The two major processes governing the fate of organic contaminants in soil are sorption-desorption and degradation [79]. Biochar amended soils are reported to have high inorganic content, high cation exchange capacity (CEC), moisture content, adsorptive capacity, and pH. Biochar increases soil’s sorption capacity for pesticides. Wheat and rice residue biochars were found to be 2500 times more effective than soil in sorbing diuron [80]. Highly carbonaceous and aromatic structure and high surface area play an important role for such high sorption [79].

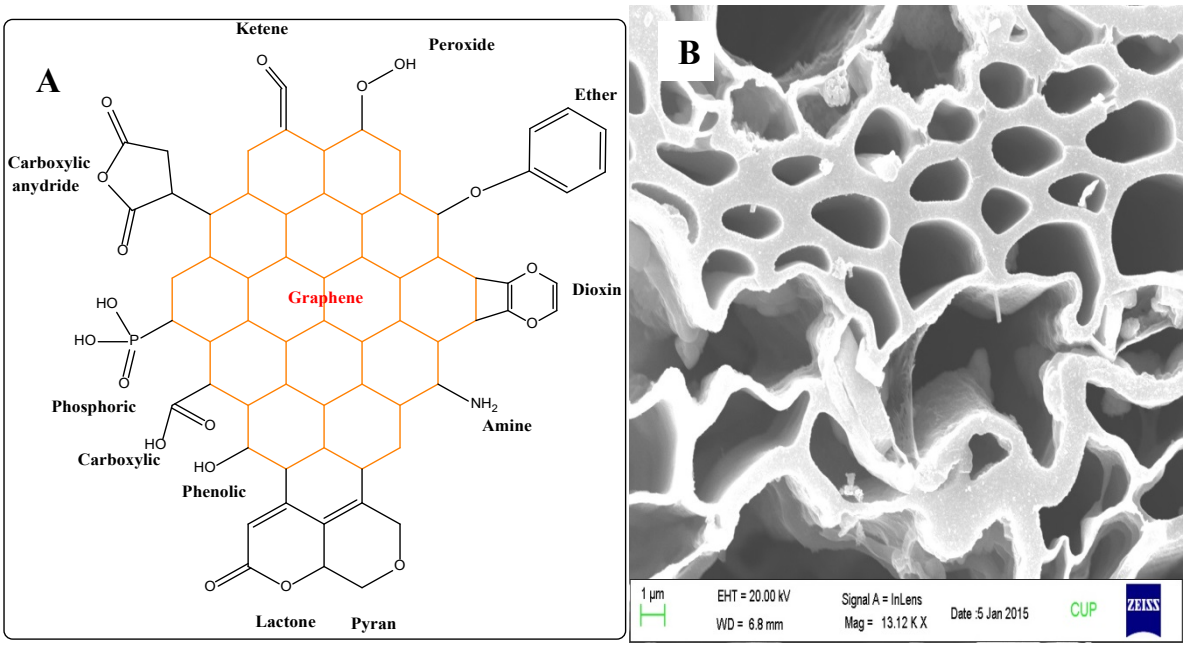

Figure2 (A) Structure of biochar with different functional groups present on its surface (Adapted and redrawn from [81]and [76]); and (B) SEM images of wheat straw biochar synthesized at 400°C.

3.1 Production of biochar

Biochar is produced through thermochemical conversion of biomass at high temperatures, usually ranging from 200-900°C with limited or no oxygen, by the process known as pyrolysis. Pyrolysis can be fast or slow. Fast pyrolysis results in more liquid fuel (bio-oil), with the lesser solid product (biochar), whereas slow pyrolysis yields a high amount of biochar and lesser liquid fuel. Residence time is <2s in fast pyrolysis, which yields about 75% bio-oil, and for slow pyrolysis, it varies from few minutes to days, with biochar as the major product (25-35%) [82,83].

Biochar yield generally depends on the temperature of pyrolysis, residence time, heating rate and type of feedstock. Sohi et al. [84] reported that high biochar yield is obtained from biomass with high lignin content. Biochars produced from crop residues and wood biomass has low carbon content and high molar H/C and O/C ratios and thus higher surface areas than those produced from animal litter and solid wastes. The heating rate is found to be the least influencing factor in determining biochar yield [85]. Pyrolysis temperature is known to affect biochar characteristics significantly. The increase in pyrolysis temperature enhances carbonization and lowers O and H contents. The surface

area of biochar also increases with increasing pyrolysis temperatures as it removes volatile material which results in high micropore volume [86]. Keiluweit et al. [87] observed a decline in biochar yield at a temperature of less than 300°C due to initial dehydration reactions. With an increase in temperature, plant-based biomass undergoes dehydration and depolymerization into smaller dissociation products of lignin and cellulose. This change can be shown by Van krevelen diagram. McKendry et al. [88] compared biomass and fossil fuels in terms of their oxygen to carbon and hydrogen to carbon ratios and inferred that these ratios are inversely proportional to the energy content of material (Fig 3).

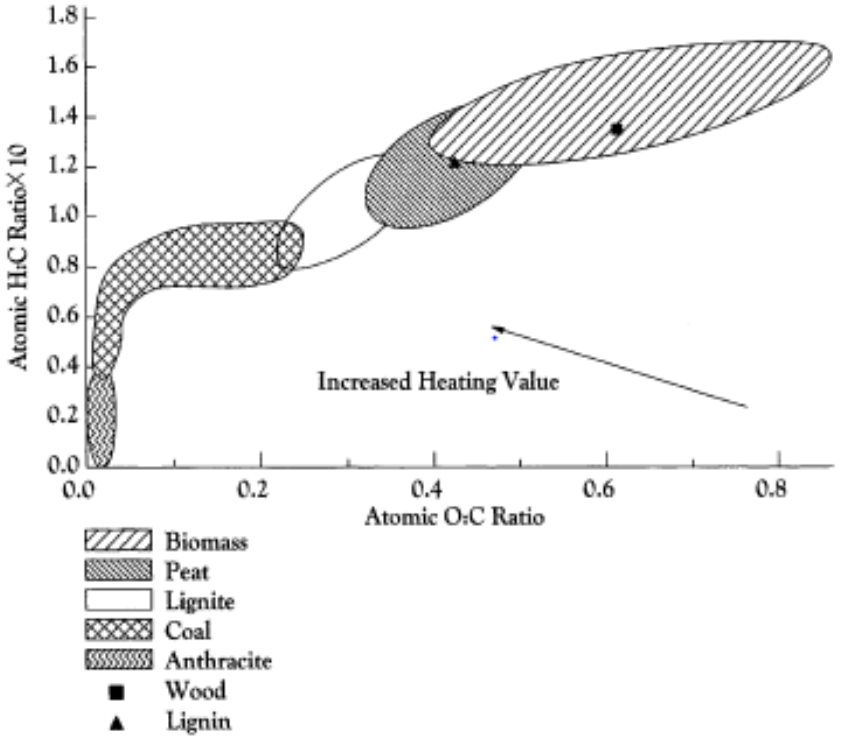

Figure 3 Van krevelen diagram depicting fuel characteristics (Source: McKendry et al. (2002).

Use of biochar as an adsorbent can be limited because of its relatively low surface area and high residual volatile matter. However, these shortcomings can be overcome by various pre- and post-treatment technologies (Fig 4). These modified biochars have large surface area and high porosity, which leads to their use as an alternative for activated carbon. Activation is suggested for enhancing biochar properties. Biochar properties can be modified by physical activation (steam activation and heat treatment) and chemical

activation (acidic or alkaline modification and impregnation methods) [89]. These two methods are successfully used to enhance the surface area and porosity of biochar [90,91,92]. The biochars thus produced from these treatment types are called *activated biochars*. In physical activation by steam, biomass is subjected to steam at 800-900°C temperature after carbonization. Heat treatment involves heating of biochar at 800-900°C for 1-2 hours to provide more basic surface functional groups which are quite efficient for sorbing hydrocarbons [93,94]. Chemical activation, which yields better porous structure [95] involves impregnation of raw material with an activating agent under heat treatment in the inert atmosphere [96]. Different oxidants are used for acidic modification of biochars to increase their acidic property by removing mineral elements [94]. It is conducted by soaking biochars in acidic solutions at 120°C in biochar to acid ratio of 1:10 [96,97]. Alkaline modification helps to adsorb negatively charged species. It is carried out by soaking biochars in different basic concentrations at 25-100°C after which pyrolysis is done with limited or no oxygen [93,98]. In impregnation, biochars are mixed with metal salts or oxides to facilitate easy adsorption of metal ions. Application of these methodologies gives biochar different properties. Azargohar and Dalai [90] investigated the effects of steam and potassium hydroxide (KOH) as a means of physical and chemical activation of biochar. The BET surface area was found to have increased when the temperature for steam and chemical activation was increased. Biochars produced from fast pyrolysis were given steam treatment, which showed enhanced sorption capacity for the removal of contaminants by increasing the biochars' surface area and porosity [91]. Wheat straw was used as a precursor for the production of activated biochar by activating it using phosphoric acid, acid treated char was heated afterward to acquire desired properties for the removal of heptachlor from aqueous solution [99].

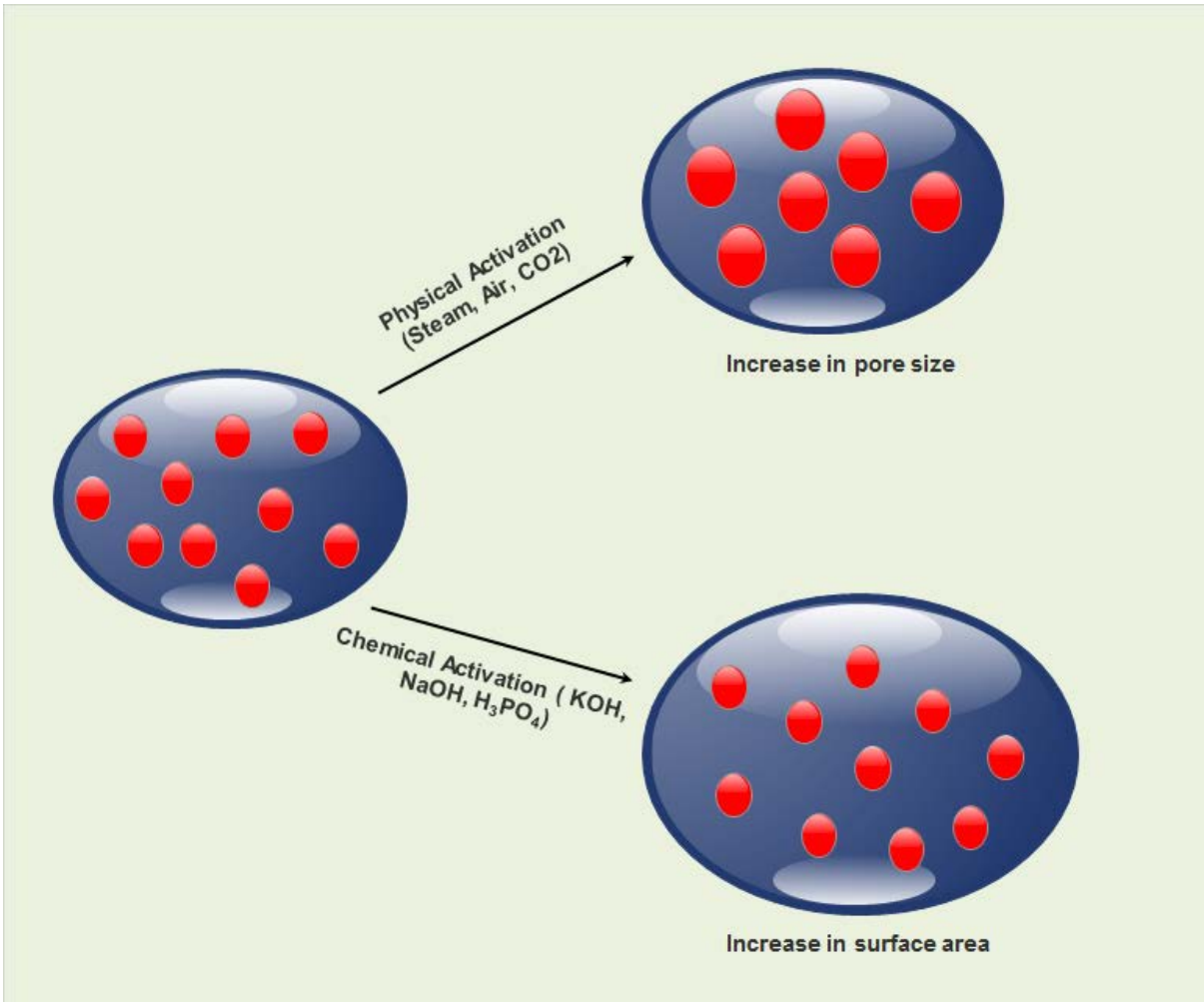

Figure 4 Physical and chemical activation of biochar leading to the different surface phenomenon.

3.2 Characteristics of biochar for adsorption

The pyrogenic conversion of waste materials into biochar is beneficial as it adds considerable economic value; helps in the reduction of waste disposal cost, and is a potentially reasonable alternative to the present commercial activated carbons. These waste materials have high adsorption capacity, considerable mechanical strength, and low ash content [100]. Pyrogenic carbon is an amorphous carbon with a high degree of porosity, which governs the way in which it performs the purifying role, and the large surface area provides multiple sites upon which the adsorption takes place [101]. The

factors which favor selection of agricultural adsorbents include widespread presence, low cost, regenerability and organic composition.

Various mechanisms such as H-bonding, cation-bridging, covalent bonding, and hydrophobic interactions are involved in adsorption of anthropogenic organic compounds onto biochar [102]. Surface properties of biochar and characteristics of adsorbate play an important role in determining the reaction rate for adsorption. For various natural and synthetic organic compounds present in terrestrial environments, aromatic structures form the major components. Different adsorption mechanisms have been suggested for interactions between aromatic π-systems of organic compounds and sorption sites at the organic matter and biochar [87]. Aromatic π-systems have been considered to be involved in π-π electron donor-acceptor (EDA) interactions, and polar-π interactions between organic matter and biochar [103,104].

The surface activity of biochar particles may become attenuated with time as the external space available for adsorption reactions diminishes with the increasing presence of organic compounds at the surface [105]. Surface activity of biochar can be affected by aging process (like pore blockage, surface oxidation, swelling, surface coverage), which has been studied in the soil in detail [106-110].Various studies on biochar from agro waste have manifested a good adsorption capacity for heavy metal contaminants such as Cu, [111-116], Zn [111,116], Pb [117, 118], and Cr [119].

Table 5 Biochar generated under various pyrolysis conditions and their adsorption characteristics for heavy metal ions.

S. No.	Agri waste	Pyrolysis Temperature (^oC)	Heavy metal	Adsorbent dose (g/L)	Optimum pH	Reaction time (h)	Amount Adsorbed (q_e) (mg/g)	Kinetics	Ref.
1.	Rice husk	300-400	Cu(II)	10	5	24	44.47		[120]
2.	Rice husk	300	Pb(II)		5	5	2.40	Pseudo second order	[117]
3.	Corn straw	600	Cu(II)	0.1	5	24	12.52	Pseudo-second-order	[111]
4.	Corn straw	600	Zn(II)	0.1	5	24	11.0	Pseudo-second-order	[111]
5.	Corn bran	600	Cr(VI)	-	2	-	86.49	-	[119]

6.	Corn cob	300-400	Cu(II)	10	5	24	2.70		[120]
7.	Banana peel	230	Pb(II)	0.01	2-7	3	359	Pseudo-second-order	[121]
8.	Switchgrass	300	Cu(II)	1	5	24	-	-	[113]
9.	Switchgrass	300	Cd(II)	1	5	24	-	-	[113]
10.	*Spartina alterniflora*	400	Cu(II)	0.5	6	-	48.8	Pseudo-second-order	[122]
11.	Eucalyptus	300-400	Cu(II)	10	5	24	3.48		[120]
12.	*Acacia*	300-400	Cu(II)	10	5	24	9.70		[120]
13.	Olive mill waste	300-400	Cu(II)	10	5	24	24.10		[120]
14.	Pine wood char	400-450	F^-	10	2-10	48	-	Pseudo second order	[118]
15.	Pine bark char	400-450	F^-	10	2-10	48	-	Pseudo second order	[118]
16.	Pine wood	300	Pb(II)	-	5	5	4.25	Pseudo second order	[117]
17.	Hardwood	450	Zn(II)	0.1	5	24	4.54	pseudo-second-order	[111]
18.	Hardwood	450	Cu(II)	0.1	5	24	6.79	Pseudo-second-order	[111]

Various studies have shown the effect of agro-wastes on pesticides and other organic contaminants in an aqueous environment (Table 6). In a study by Cederlund et al. [123], heat treatment was found to enhance adsorption and decrease desorption of bentazone and 2-methyl-4-chlorophenoxyacetic acid (MCPA). Chemical treatment using magnetite increased the adsorption of glyphosate, decreasing desorption of chlorpyrifos. Chlorpyrifos and diuron were adsorbed on untreated biochar owing to their high octanol-

water partition coefficients, whereas glyphosate was least adsorbed. The adsorption capacity of biochar iron composite was found to be highest for all pesticides [123]. In another study, the efficiency of rice husk agro waste in nano-sorbent form for removal of 2,4 D was 96.87% removal of the contaminant at pH 5.0, temperature 30°C, the adsorbent dosage of 1.5 g/l attaining an equilibrium within an hour [71].

Sorption of pesticides was found to be more with biochar compared to soil or soil amended with raw material (straw) [78,79]. At intermediate and quasi-equilibrium conditions 48-55 and 66.6-72.4% sorptions were achieved respectively, for soil amended with biochar compared to control and straw for simazine [78].

Table 6 Selected reports on adsorption-desorption of contaminants with biochar amended media.

S. No.	Biochar	Organic contaminant	Pyrolysis temperature (°C)	Surface area (m^2/g)	Adsorption Conditions	Loading rate (g/L)	Amount adsorbed (mg/g)	Ref.
1.	Soybean stover	Trichloroethylene	300	6	pH=7 2880 min	0.3	9.85	[101]
2.	Soybean stover	Trichloroethylene	700	420	pH=7 2880 min	0.3	25.38	[101]
3.	Peanut shells	Trichloroethylene	300	3	pH=7 2880 min	0.3	7.79	[101]
4.	Peanut shells	Trichloroethylene	700	448	pH=7 2880 min	0.3	30.74	[101]
5.	Switchgrass	Metribuzin	425	1.1	pH 2 1440 min	1	223	[124]
6.	Olive kernel (Physical activation under steam)	Bromopropylate	800	600	75 min	5	0.094	[125]
7.	Corn cobs	Bromopropylate	800	630	135 min	5	0.086	[125]

	(Physical activation under steam)							
8.	Rapeseed stalks (Physical activation under steam)	Bromopropylate	800	490	135 min	5	0.0893	[125]
9.	Soya stalks (Physical activation under steam)	Bromopropylate	800	570	135 min	5	0.078	[125]
10.	Corn cob	Atrazine (A) and imidaclopr id (I)	600	242.1	1440 min	0.1	18.0–30.4%(A),(14.7–28.4%(I)	[126]
11.	Eucalypt us bark	Atrazine (A) and Imidaclopr id (I)	600	188.2	Conta ct time= 1440 min, 27°C	0.1	23.4–40.1%(A),5.9–20.1%(I)	[126]
12.	Rice husk	Atrazine (A) and Imidaclopr id (I)	600	159.1	1440 min	0.1	11.8–42.6%(A), 28.0–46.2%(I)	[126]
13.	Rice straw	Atrazine (A) and Imidaclopr id (I)	600	220.2	1440 min	0.1	37.5–70.7%(A),	[126]
14.	Corncob	Methylene blue	400	700	45min	2	28.65	[127]
15.	Corncob	Methylene blue	500	633	120mi n	2	17.57	[127]
16.	Corncob	Methylene blue	600	600	120 min	2	0.809	[127]
17.	Korean cabbage	Congo red	500	11.44	pH=9. 18, 1440	1	21.9	[128]

					min			
18.	Rice straw	Congo red	500	34.73	pH=8.61 1440 min	1	13	[128]
19.	Rice straw	Crystal violet	500	34.73	pH=8.61 1440 min	1	261.5	[128]
20.	Wood chips	Congo red	500	<0.01	pH=4.71 1440 min	1	9.4	[128]
21.	Wood chips	Crystal violet	500	<0.01	pH=4.71 1440 min	1	78.21	[128]
22.	*Jatropha curca* pods	Remazol,brilliant blue R	600		pH=3	8	90%	[129]
23.	Wheat straw	Heptachlor	500	176.4 ± 5.6, 0.631 cm3 g-µm	pH=7 180 min	2	2.218	[99]
24.	Groundnut shell biochar	2, 4-dichlorophenoxyacetic acid	650	43	pH=8.5	40	3.02	[75]
25.	Groundnut shell activated carbon	2, 4-dichlorophenoxyacetic acid	800	709	pH=9.7	0.6	250	[75]
26.	Rice straw	Phenol	550	71.35	1440 min	2	83.4	[130]
27.	Rice straw	Phenol	550	143.3	KOH	2	93.5	[130]
28.	Rice straw	Phenol	550	87.2	HNO_3	2	66.8	[130]
29.	Rice straw	Phenol	550	56.9	H_2SO_4	2	65.6	[130]
30.	Rice straw	Phenol	550	110.9	H_2O_2	2	80	[130]
31.	Rice straw	Phenol	550	87.75	$KMnO_4$	2	64.2	[130]

Yavari et al. [131] found that biochars produced from oil palm empty fruit bunches were more efficient for the sorption of polar pesticides like imazapic and imazapyr. This sorption behavior is accounted to the elemental composition and surface functional groups on the oil palm biochar as compared to rice husk derived biochars. It was observed that low pyrolysis temperature retains organic functional groups on biochar's surface, which leads to higher sorption of these polar pesticides.

The surface functional moieties on biochar had a significant influence on adsorption than the surface area of the biochar at elevated pyrolysis temperature. In contrast to this study, biochar obtained at high temperature was more effective at terbuthylazine (non-polar pesticide) adsorption than the one produced at lower temperature [132]. This affinity for non-polar molecules is accounted to the non-polar nature of surface as well as increased porosity of biochar produced at elevated pyrolysis temperature. Trivedi et al. [75] highlighted the effect of preparation conditions on adsorption of 2, 4-D on groundnut shell biochar prepared at 650 and 850^{o}C. The surface area and organic carbon content increased with thermal activation of biomass, which enhanced the sorption capacity. Phosphorous treated and untreated rice husk biochar (RHBC) showed maximum herbicide sorption as compared with eucalyptus bark, corn cob, and bamboo chips, prepared under similar operating conditions. The cation exchange capacity, pore volume, and polarity of RHBC were highest among other biochars. The performance of RHBC was further enhanced by phosphoric acid treatment as it increased the functional groups on the surface of biochar pores. Apart from this, the surface area for RHBC was lowest. Pore size and pore volume show good correlation with adsorption onto biochar whereas no correlation was observed with a surface area of biochar [126]. Carbera et al. [133] related sorption of bentazone on the biochar-amended soil to surface area and dissolved organic carbon (DOC) content of biochar. Sorption was lesser on biochar with high DOC, as DOC has the tendency to get adsorbed to soil particles, hence competing with herbicides for adsorption sites. On the other hand, sorption of aminocyclopyrachlor increased in biochar with high surface area and low DOC due to the interactions between biochar DOC and mineral soil surfaces. Polar herbicides such as glyphosate and 2-methyl-4-chlorophenoxyacetic acid (MCPA) were weakly adsorbed on biochar owing to the negative charge on biochar surface which offered electrostatic repulsion [77]. soybean stover and peanut shells biochars produced at 700 and 300˚C have studied for Trichloroethylene (TCE) adsorption [101]. Low adsorptive properties of the biochars produced at 300˚C were attributed to high oxygen content or low carbon content at low temperature. Adsorption capacity was positively correlated with carbon content but negatively correlated with an oxygen content of biochars. This positive and negative correlation with C and O content of biochar, respectively, with adsorption of TCE, is

attributed to the hydrophobicity of biochar and to the removal of acidic functional groups. The surface functional moieties on the char result in increased polarity of biochar produced at low pyrolysis temperature. This results in reducing the adsorption of TCE, as polar sites are known to hinder the removal of TCE due to the formation of water clusters. Low oxygen content in high-temperature biochars hindered the formation of water clusters and enhanced adsorption of TCE. Another reason for high adsorption with rising temperature was the formation of micropores which increases surface area leading to greater diffusion of TCE.

4. Conclusion

Lignocellulosic biomass-based agricultural residues have been extensively studied for remediation of heavy metal and organic contaminants in water and wastewater. The basic approach involves raw biomass physicochemically treated biomass and pyrolyzed biomass (biochar) for use as surface active adsorbents for heavy metals and organic contaminants. Limited studies on the physicochemically treated biomasses and their applications in adsorption of heavy metal or organic contaminants are available. There is a substantial promise in the usage of biochar as an adsorbent for heavy metal and pesticides.

One of the major concerns about adsorption is the disposal of the waste generated in the process. It is believed that lignocellulosic can be used in further thermochemical processes (combustion & pyrolysis) whereby the ash liberated would carry the adsorbate and be concentrated significantly, up to 50 times in case of heavy metals. This would have the added advantage that the thermochemical processes are catalyzed by the heavy metal adsorbates leading to a variety of value-added biorefinery products. On the other hand, the organic impurities volatilize and yield more toxic products. The other alternatives of regeneration and reuse are cost and environmentally ineffective so far. However, efforts are required in the management of these adsorption based wastes for the effective use of industrial wastewater and water treatment technologies.

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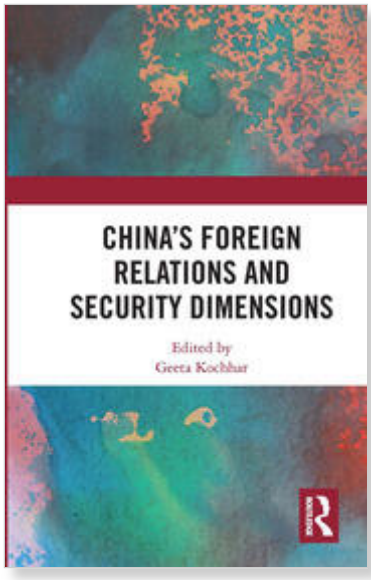

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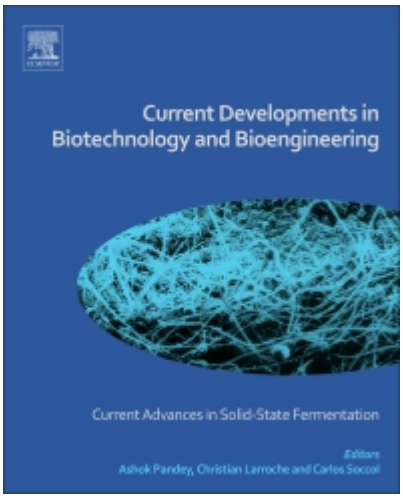

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Characterising the Culture of the Mughal Era

Chronicles of a Munshi

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Updated on 28 September 2018

Vikas Rathee (/author/vikas-rathee)

Writing Self, Writing Empire: Chandar Bhan Brahman and the Cultural World of the Indo–Persian State Secretary *by Rajeev Kinra, Delhi: Primus Books (by arrangement with University of California Press), 2016; pp xix+369, ₹1,250.*

Writing Self, Writing Empire by Rajeev Kinra is a biography of Chandar Bhan Brahman, a 17th-century Mughal munshi. (He died in the 1660s, Brahman was his caste and also his *takhallus* or pen name.) Simultaneously, *Writing Self, Writing Empire* is also a history of the political and administrative culture of the Mughal empire during Shah Jahan's reign (1627–58), and a contribution to the literary history of Persian in India. The book is part of a larger trend of writing Mughal and medieval Indo–Islamic history (also referred to as "early modern") that has focused largely on cultural history of the Indo–Islamic milieu and shown how this was a "cosmopolitan" venture comparable to other similar "early modern" polities in West Asia and Europe (Breckenbridge et al 2002; Lefèvre et al 2015). Theoretically, "cosmopolitan-ism" has been expounded by academic figures based in the West such as Kwame Anthony Appiah. Appiah sees cosmopolitan-ism as "a rejection of the conventional view that every civilized person belonged to a community among communities," and as "regard[ing] all the peoples of the earth as so many branches of a single family, and the universe as a state" (Appiah2006).[1] However, cosmopolitan-ism does not convincingly explain why a humanbeing should feel belonging towards all of humanity more than towards any other community. In fact, is it possible to transcend cultural moorings and become "universal," and would not any such transcendence not inaugurate yet another cultural formation that would with time become "particular"? The history of all ideologies, for example, Christianity,Islam, Marxism, Democracy or AryaSamaj, suggests so.

Methodologically, this research output is based on close philological engagement with a variety of original sources. Kinra applies the model of "cosmopolitan-ism" to the Mughal cultural world and Chandar Bhan Brahman is his test case. The book derives from a close reading of two texts from Chandar Bhan's literary oeuvre, namely the *Chahar Chaman* (Four Gardens) and the *Munsha'at-i Brahman* (Epistles of Brahman). This is supplemented by data from a variety of contemporary and subsequent histories and commentaries that discuss Chandar Bhan's life and career as a poet andadministrator.

The Munshi

In the 20th century, the Persian munshi is already a relatively forgotten figure. However, as late as the early 19th century, colonial officials were made to read English translations of the *Chahar Chaman*. Ethnically, the munshi could be a Hindu or a Muslim from South Asia, or a Muslim or Zoroastrian from Iran and Central Asia. Amongst Hindus, certain castes traditionally associated with literacy, such as Khatris, Kayasthas and Brahmins, formed the bulk of munshis. Using the biographical framework, Kinra documents the sociocultural processes through which Indian Muslims and Hindus became munshis, and acquired Persian as a language of poetry and bureaucracy. This description gives reasons behind the acceptance and success of the Mughal rule. Kinra suggests that the Mughal rule was part of a wider "cosmopolitan" world of Persian language, literature and culture that included the Ottoman and Safavid empires, and other political formations in Central and South Asia. Kinra foregrounds forgotten evidence, and provides a detailed description of active and willing Hindu presence in the Mughal empire. He shows how dominant stereotypes of the present-day do not fit the evidence from the 17th-century Mughal realm. The strength of Kinra's work lies in the attention provided to the figure of the munshi, his

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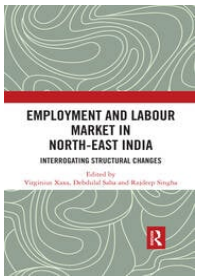

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Abstract

This chapter presents the fundamental properties of polymer nanocomposites (PNCs) and their characteristics that play a significant role in deciding their capability for the advanced energy storage devices. The various synthesization methods used for the preparation of polymer electrolytes are described followed by the characterization techniques used for the analysis. The properties of the polymer host, salt, nanofiller, ionic liquid, plasticizer, and nanoclay–nanorod–nanowire are described. Various ion transport mechanisms with different nanoparticle dispersions in polymer electrolytes are highlighted. Various important results are summarized, and a pathway is built to fulfill the dream of the future renewable source of energy that is economical and environmental benign. Chapter motivation is focused on the investigation of the role of polymer host, aspect ratio, surface area, nanoparticle shape, and size in terms of boosting the electrolytic–electrochemical properties of PNC. It will certainly help in order to open new doors toward the development of advanced polymeric materials with overall balancing property for enhancement of the fast solid-state ionic conductor which would revolutionize the energy storage–conversion device technology.

Keywords

Li-ion battery Polymer nanocomposites Electrical properties Ion transport mechanism

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Abstract

Natural plants and their derived products are effective against various diseases for their prevention and treatment for several years. Availability of synthetic drugs with faster and selective responses against various diseases decreased the use of herbal products. However, due to adverse side effects of synthetic drugs, in the last few years, the clinical use of plant-derived medicines has been exponentially increased in developing as well as developed countries due to their easy availability, low cost, and least toxicity. Therefore, in recent years, several human trials have been done to analyze the toxicology, pharmacokinetics, and biologically effective dose of phytochemicals against cancer, diabetes, and bacterial and viral diseases for their clinical application. In the present book chapter, we have discussed the clinical studies on phytochemicals against several diseases including diabetes, cancer, and diseases associated with microbial infections including women health problems.

Keywords

Phytochemicals Drug discovery Clinical trial Women health Cancer Bacterial diseases Viral diseases

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Abstract

Cardiovascular diseases (CVDs) are multifactorial noncommunicable diseases that are responsible for most prominent health problems worldwide in the twenty-first century. The genetic factors, environmental factors, change in diet, lifestyle, lack of physical activities, stress, and high blood pressure are the key risk factors for CVDs, and diseases like diabetes also contribute to the progression of CVDs. Platelet aggregation, vascular endothelial dysfunction, and imbalance in nitric oxide (NO) levels are the key events in cardiovascular pathologies that results in inflammation and oxidative stress that ultimately leads to death. To counteract the pathogenicity of CVDs, the use of phytochemicals is advancing as the conventional drugs have multiple side effects. Experimental demonstrations have showed that phytochemicals exhibit numerous cardioprotective properties with limited side effects. This chapter is focused on the use of resveratrol (3,5,4′-trihydroxystilbene), a phytochemical well known for its cardioprotective, antioxidant, anti-inflammatory, anti-atherosclerotic properties *in vitro* and *in vivo*. Existing systemic studies revealed that resveratrol could target various signaling pathways associated with cell growth and proliferation, inflammation, and mitochondrial functioning by modulating PGC-1α and SIRT-1 activity and also improves remodeling in the heart by activating adenosine monophosphate kinase (AMPK). Resveratrol can act as an inhibitor of migration and proliferation of aortic vascular smooth muscle cell by decreasing the cross talk between an inducer of matrix metalloproteinases (MMPs) and IL-18. Resveratrol improves the systolic performance of heart by regulating diastolic function and thus prevents heart failure risk. Scientific literature shows that the use of resveratrol as miracle drug for vascular pathogenesis can revamp cardiac health which will shed light on the path to make treatment strategies for medication of vascular-related disorders.

Keywords

CVDs Inflammation Oxidative stress Phytochemicals Resveratrol

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Chapter 14: India: rising trends of international and internal migration

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Abstract

This chapter explores the trends and patterns of international and internal migration with respect to India, including their underlying causes and socio-economic consequences, using secondary data compiled from various sources such as the United Nations Global Migration Database (UNGMD) and the National Sample Survey (NSS) of India. The chapter explores the nature, growth and composition of international and internal migration and the consequent implications in terms of growth, remittances, urbanisation and so on. Following an introductory section, the chapter explains the trends and patterns of international migration – its underlying reasons. It also provides details of remittances and their role on poverty, economic growth and overall socio-economic development in India. It then explores the trends and patterns of internal migration, and its causes and consequences on urbanisation in India, before providing concluding remarks.

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Hormones of Hypothalamus in Aging

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Abstract

Hypothalamus being the master regulator of the vertebrate endocrine system undergoes many adjustments/alterations which body makes during the course of aging. Moreover, the endocrinological basis of aging in male and female organisms is very complex, with multiple hormones along the hypothalamic-pituitary (HP) axis interacting with each other via different feedback loops to maintain homeodynamic state. Also the sensitivity of the hypothalamus to the external stimuli decreases with age mainly due to its lack of sensitivity towards the feedback system The endocrine system is although severely affected by aging but all the organ systems are not affected at the same time or in the same way. During aging cellular protein synthesis machinery as well as immune functions are diminished and gradually physiological functions decline. There is also an increase in fat mass, a loss of muscle mass and strength, and a decrease in bone mineral density profile that contribute to declining health status with increasing age. The hallmarks of aging such as Genomic instability, Telomere attrition, Epigenetic alterations, Loss of proteostasis, Dysregulated Nutrient Sensing, Mitochondrial dysfunction, Altered intracellular communication, Cellular senescence etc. are well reported in literature. In this chapter we have compiled information and discussed various hormonal changes that occur with age in hypothalamus and pituitary gland and how these two master regulators gradually lose their sensitivity with the increasing age.

Keywords

Hypothalamus Regulation Receptors Thyrotropin Oxytocin Vasopressin Somatostatin Reproduction Menopause Neurotransmitters

Gurcharan Kaur and Jyoti Parkash are equally contributing authors.

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ELEMENTARY EDUCATION
Trends and Concerns

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Content

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Integration of Yoga in Primary Education Curriculum for Harmonious Development of Children

Dr. Shamshir Singh
Assistant Professor, Centre for Education
Central University of Punjab, Bathinda.

Introduction

Yoga is of great importance to mind and body because of the way it looks at life.The term Yoga education has been commonly referred to as the training and teaching process of Yoga. The main aim of both yoga and education is harmonious development of the personality of the individual enabling him to become worthy citizen of the country. In achieving this aim Yogic education can play a vital role by laying the foundation stone during the formative years of the life of individual. The Educationists of the present 21st century have started taking interest in improving the quality of education with the help of the

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Ciro D'Apice, Umberto De Maio, and Peter I. Kogut, "On Optimal Control of Quasi-Linear Elliptic Equation with Variable p(x)-Laplacian," Lecture Notes in Engineering and Computer Science: Proceedings of The World Congress on Engineering 2018, 4-6 July, 2018, London, U.K., pp1-6

A Numerical Investigation of VMS-POD Model for Darcy-Brinkman Equations

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Exact Solutions of Some Complex Non-Linear Equations

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Sachin Kumar, "Exact Solutions of Some Complex Non-Linear Equations," Lecture Notes in Engineering and Computer Science: Proceedings of The World Congress on Engineering 2018, 4-6 July, 2018, London, U.K., pp12-13

Exact Solutions of Some Complex Non-Linear Equations

Sachin Kumar, *Member, IAENG*

***Abstract*—Exact solutions of the coupled Higgs and Maccari system are obtained. Travelling wave solutions of coupled Higgs equation and Maccari system in the form of Jacobi's elliptical functions are presented.**

***Index Terms*—exact solutions, coupled Higgs equation, Maccari system**

I. Introduction

COMPLEX physical phenomena in various fields of sciences, especially in fluid mechanics, solid state physics, plasma physics, plasma wave and chemical physics are represented by nonlinear evolution equations (NEEs). Analytical solutions of such equations are of fundamental importance. In the literature, quite a few methods have been proposed for constructing explicit travelling and solitary wave solutions of nonlinear evolution equations, such as the inverse scattering method [1], tanh-sech method by author(s) [8], [10], sine cosine method [2], [9], [11], ansatz method [4], etc.

The coupled Higgs equation [6]

$$\begin{aligned} &u_{tt} - u_{xx} + |u|^2 u - 2uv = 0 \\ &v_{tt} + v_{xx} - (|u|^2)_{xx} = 0, \end{aligned} \tag{1}$$

describes a system of conserved scalar nucleons interacting with neutral scalar mesons.

Attilio Maccari derived a new integrable (2 + 1)-dimensional nonlinear system [5]

$$\begin{aligned} &iu_t + u_{xx} + uv = 0 \\ &v_t + v_y + (|u|^2)_x = 0. \end{aligned} \tag{2}$$

The integrability property was explicitly demonstrated and the Lax pair was also obtained.

Bekir in [2] looked for exact solutions of the coupled Higgs [6] and Maccari system [5] using the tanh-coth [10] and the sine-cosine [7], [11] methods.

II. Travelling wave solutions

A. Coupled Higgs equation

Assume that coupled Higgs equation (1) has a travelling wave solution in the form

$$u = e^{i\theta} U(\xi), \quad v = V(\xi), \quad \theta = px + rt, \quad \xi = x + ct, \tag{3}$$

where p, r, c are arbitrary constants. Substitution of (3) into Eq. (1) reduces the PDEs to system of ordinary differential equations (ODEs)

$$\begin{aligned} &(c^2 - 1)U'' + r^2(c^2 - 1)U - 2UV + U^3 = 0 \\ &(c^2 + 1)V'' - 2(U')^2 - 2UU'' = 0, \end{aligned} \tag{4}$$

with condition $p = rc$.

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Integrating the second equation in the system and neglecting the constant of integration we get

$$(c^2 + 1)V = U^2 \tag{5}$$

Substituting (5) into first equation of system (4), we find

$$(c^2 + 1)U'' + r^2(c^2 + 1)U + U^3 = 0. \tag{6}$$

Integrating equation (6) we get

$$U'^2 = -\frac{U^4}{2(c^2+1)} - r^2U^2 + \frac{C_1}{2(c^2+1)}, \tag{7}$$

where C_1 is arbitrary constant. Again integrating we get following solution of equation (6)

$$U(\xi) = \frac{a_3\sqrt{2}sn\left(1/2\sqrt{2\,a_2 + 2\sqrt{{a_2}^2 + 4\,a_1a_3}}\xi + C_2, m\right)}{\sqrt{a_3\left(a_2 + \sqrt{{a_2}^2 + 4\,a_1a_3}\right)}}, \tag{8}$$

where sn is Jacobi elliptic sine function and

$$\begin{aligned} m &= \frac{\sqrt{-2\left(2\,a_1a_3 + {a_2}^2 + a_2\sqrt{{a_2}^2+4\,a_1a_3}\right)a_1a_3}}{2\,a_1a_3 + {a_2}^2 + a_2\sqrt{{a_2}^2+4\,a_1a_3}}, \\ a_1 &= \tfrac{1}{2(c^2+1)},\ a_2 = r^2,\ a_3 = \tfrac{C_1}{2(c^2+1)}. \end{aligned} \tag{9}$$

Corresponding solution of Higgs field equation is

$$\begin{aligned} u(x,t) &= \frac{a_3\sqrt{2}sn\left(1/2\sqrt{2\,a_2+2\sqrt{{a_2}^2+4\,a_1a_3}}(x+ct)+C_2,m\right)}{\sqrt{a_3\left(a_2+\sqrt{{a_2}^2+4\,a_1a_3}\right)}}e^{(ir(cx+t))} \\ v(x,t) &= \frac{2a_3sn\left(1/2\sqrt{2\,a_2+2\sqrt{{a_2}^2+4\,a_1a_3}}(x+ct)+C_2,m\right)^2}{(c^2+1)\left(a_2+\sqrt{{a_2}^2+4\,a_1a_3}\right)}, \end{aligned} \tag{10}$$

where m, a_1, a_2 and a_3 are given by (9).

B. Maccari system

Let us consider the travelling wave solution of Maccari system (2) in the form

$$u = e^{i\theta}U(\xi), \quad v = V(\xi), \theta = px + qy + rt, \xi = x + y + ct, \tag{11}$$

and corresponding system of ODEs is

$$\begin{aligned} &U'' - (r + p^2)U + UV = 0 \\ &(1 - 2p)V' + 2UU' = 0. \end{aligned} \tag{12}$$

with condition $c = -2p$.

Integrating the second equation and neglecting the constant of integration we find

$$(2p - 1)V = U^2. \tag{13}$$

Substituting (13) into first equation of the system (12), we find

$$(1 - 2p)U'' - (1 - 2p)(r + p^2)U - U^3 = 0. \tag{14}$$

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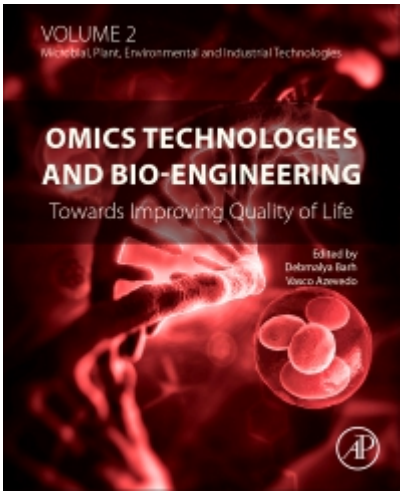

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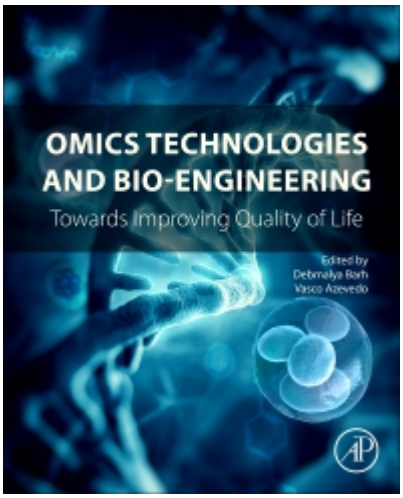

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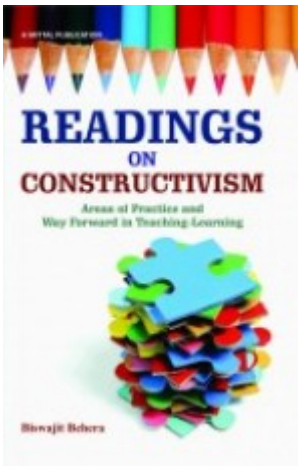

Readings on Constructivism: Areas of Practice and Way Forward in Teaching-Learning

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Description

This book is a comprehensive study on constructivism approach of teaching and learning. Many reforms have taken place in the last decade and Indian system of education is geared towards paradigm shift of Education. The conventional system of education is rejected due to lack in the process of education. The teacher centered classroom has been outdated. The process is more important than product of learning. Various commissions and committees, great thinkers in the field of education have out rightly suggested making learning joyful for the children. Therefore, an attempt is being taken to build a sense of

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Flavonoid Secondary Metabolite: Biosynthesis and Role in Growth and Development in Plants

Recent Trends and Techniques in Plant Metabolic Engineering pp 19-45

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Chapter

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Abstract

Flavonoids are main class of secondary metabolites and occur in different tissues and organs in diverse plant species. The higher accumulation of flavonoids in a wide variety of fruits and vegetables increases their economical value because flavonoids are good for human health. It has been established that flavonoids help the plants to protect against adverse environmental constraints and have not played a significant role in plant growth and development. A number of recent reports provided strong evidences in support of significant role of flavonoids in growth and development. The objective of this chapter is to provide an overview of the flavonoid biosynthetic pathway and review the significant contribution of flavonoids in growth and development of plants. This study provides an in-depth understanding of the role of flavonoids and is useful for further manipulation of flavonoids for growth and development of wide types of plant species.

Keywords

Flavonoids Growth Adaptation Development Plants

Abbreviations

ANR	Anthocyanin reductase
APX	Ascorbate peroxidase
CAT	Catalase
CHI	Chalcone isomerase
CHS	Chalcone synthase
DFR	Dihydroflavonol reductase
EC	Epicatechins
FLS	Flavonol synthase
GR	Glutathione reductase
GT	Glycosyl transferase
NADH	Nicotinamide adenine dinucleotide hydrate
PAL	Phenylalanine ammonia lyase
PHE	Phenylalanine

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Recent Trends and Techniques in Plant Metabolic Engineering

Editors (view affiliations)

Sudesh Kumar Yadav, Vinay Kumar, Sudhir P Singh

Provides insights into designing strategies to manipulate secondary metabolites in plants

Discusses comprehensively topics ranging from basic principles to practical applications of secondary metabolites

Provides up-to-date information on metabolomics and ways to harness the huge pool of genome data that is available

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Recent Advances in Plant Metabolites Analysis, Isolation, and Characterization

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Abstract

Metabolites from natural sources either from terrestrial or marine sources serve as unmatched resources for new drug leads or diverse chemical identity. Due to ever-rising requirement for new pharmacophore in high-throughput screening and discovery for therapeutic drugs from metabolites, there has been motivated interest particularly in edible plants around the globe. Bioactive compounds are indispensable component present in different forms of botanicals, nutraceuticals, and herbal preparations used for the various medicinal applications. The prime focus in present chapter is to enlighten and discus diverse analytical methodologies which have been applied during extraction, isolation, and characterization of active constituents in botanicals, nutraceutical, and herbal preparations.

Keywords

Plant Metabolites Extraction Chromatographic techniques Spectroscopy Quality Control

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Current Approaches and Key Applications of Plant Metabolic Engineering

Recent Trends and Techniques in Plant Metabolic Engineering pp 47-61

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Abstract

The diversion of carbon flux toward biosynthesis of targeted products could be achieved by manipulation of targeted biosynthesis pathway in plants. This whole process consists of many steps in stepwise manners starting with the identification and isolation of targeted metabolites, elucidation of complete biosynthetic pathway for identification of point of intervention, discovery of corresponding potential metabolic genes, and overexpression of the selected genes in heterologous system and collectively production of the metabolites. The various biochemical processes including transcriptome, translatome, proteome, and reactome are being used to assist metabolic engineering by providing new insights into novel pathways or bottlenecks of existing pathways. Apart from all these, in-depth understanding of metabolic fluxes and feedback regulations is also mandatory for plant metabolic engineering. All these different current approaches are collectively considered for investigating the plant metabolic engineering to understand, reconstruct, analyze, and annotate the targeted pathways. The key applications of plant metabolic engineering have been compiled with a few important applications including improvement of nitrogen utilization in plant, development of highly nutritive food, and generation of biofuel production. In conclusion, the plant metabolic engineering could provide comprehensive evaluation of manipulation of biosynthetic pathways for numerous applications. This compiled information could act as a resource for crop breeding and biotechnology purposes.

Keywords

Plant Metabolic engineering Proteins Metabolites

Abbreviations

RBS	Ribosomal binding site
NNAAs	Nonnatural amino acids
ORF	Open reading frame
TAG	Triacylglycerol

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An Update Towards the Production of Plant Secondary Metabolites

Recent Trends and Techniques in Plant Metabolic Engineering pp 1-17

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Abstract

Plants possess a large number of organic compounds performing vistas of physiological functions associated with plant defence and protection. Due to their no direct role in primary metabolism, they are called as secondary metabolites (SM). These compounds perform a variety of functional roles such as protectant against UV radiation, an attractant for insect feeding purpose, signal molecule during the nitrogen fixation and oligomeric flavonoid in the formation of bark and wood. SM production in plants involves different strategies. Plant cell and tissue cultures have huge potential in the production of a variety of secondary metabolites. Elicitation strategies using abiotic and biotic factors have been found to increase the levels of SM. Metabolic engineering (ME) or pathway engineering is also a potent tool in the scalable, selective and economical production of SM. Using this strategy, the increased titre of therapeutically important compounds like artemisinin, reticuline, paclitaxel and strictosidine has been obtained in heterologous hosts like *Escherichia coli* and *Saccharomyces cerevisiae*. Similarly increased titre of various SM has been obtained by engineering native plant biosynthetic pathways via gene overexpression or silencing transcription factors (TF), and manuplation of key biosyntheic pathway genes. Locational engineering based upon the intensification of enzyme concentration and presence of transporter molecules which carry metabolites to exact locations has also been used to engineer SM biosynthesis. Using this strategy increased levels of triterpenes and sesquiterpenes have been obtained in the plastids and mitochondria of tobacco plants. Novel and unnatural SM can be generated via swapping enzymes and reconstruction of metabolic circuits between various biosynthetic pathways. CRISPR/Cas9 is another potent upcoming gene-editing tool modulating SM biosynthesis. It has been successfully used in altering SM (tanshinones) biosynthesis in *Salvia miltiorrhiza*. Reports of enhancement in terpene and flavonoid content in tomato using RNAi have been also documented.

Keywords

Secondary metabolites Terpenoids Alkaloids Metabolic engineering

Abbreviations

SM	Secondary metabolites
UV	Ultraviolet
PTC	Plant tissue culture
TF	Transcription factor

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ROLE OF ICT IN TRANSFORMING TEACHER EDUCATION

*Dr. Shamshir Singh**

Introduction

During the past decade educational institutions have provided very limited choice in terms of manner of instructional methods. The students had no choice but rather to accept the traditional methods of instruction, ICT and its applications have provided the breakthrough by offering new choices and options to the students in the process of teaching and learning. These options provided flexibility to the students in choosing when, where and how to learn. Technology in general and intelligent-flexible technologies in particular provides effective ways for interactive learning and shall determine future directions that delivery of education takes. Some of the global trends in ICTs include convergence, miniaturization, increased mobility, enhanced processing power and reduced cost.

- **Transcend time and space:** Educational institutions have been offering programmes through distance mode for many years now and considerable amount of research and development has been associated with establishing most effective practices and procedures that should be followed in education through distance mode. (Moore & Kearsley, 1996).One outstanding feature of ICTs is their ability to transcend time and space. ICTs make possible asynchronous learning (learning characterized by a time lag between delivery of instruction and its reception by learners). Online course materials, for examples, may be accessed, 24 hours a day, 7 days a week (Young, 2002). ICT-based educational delivery (e.g. educational programming broadcast over radio or television) also dispenses with the need for all learners and the teachers to be in one physical location. In addition, certain types of ICTs, such as teleconferencing technologies, enable the instruction to be received simultaneously by multiple, geographically dispersed learners (i.e. synchronous learning).
- **Access to Remote Learning Resources:** Teachers and learners no longer have to rely solely on printed books (and available in limited quantities) for their educational needs. With the availability of internet, a wealth of learning matter in almost every field can now be accessed from anywhere at any time of the day and that too, by unlimited number of people. This is particularly significant for vast majority of schools

* Assistant Professor, Central University of Punjab, Bathinda

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COGNITIVE REFLECTION (MCR)

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ABSTRACT

The core of learning is to develop basic forms of understanding which is characterized by forms and processes of verification, validation and justification, knowledge creation and creativity. Explicit and articulated knowledge as well as tacit and experimental knowledge, creativity and excellence are all integral to the form of knowledge and knowing. It is therefore to organize learning experience to empower 'learner' and 'transform learning'. Reflection is critical to learning and transfer; it means to be embedded in assessment. A related approach is to require learning to serve a Meta cognitive reflection (MCR). This strategy is the presentation of multiple perspectives to learners by providing multiple representations on the content because there is no single schema. Metacognition helps the learners to integrate their facts and apply them to solve problems in the real world. Therefore, Constructivist pedagogy can become the medium for practice of reflection. Strategies like reflective lesson logs, reflective journal, self assessment question, wait time and group processing which provide opportunities for use of Meta cognitive reflection are suggested.

Keywords: *Constructivist pedagogy, reflection, Meta cognitive reflection (MCR).*

INTRODUCTION

The basic purpose of learning is to enable learners to make sense of life and develop their potential to a maximum extent. Therefore, NCF-2005 in its guiding principles has stipulated ideas like

1. Connecting knowledge to life outside the school
2. Making examinations integrated into class room life.

These concerns to respond critical pedagogy in school education as well asin teacher education. An effective pedagogy can become the medium for

1. Connecting classroom knowledge to the life experiences of the learners
2. Facilitating a growing appreciation of cumulative human experience
3. Knowledge and theories by building rationally upon the contextual experiences

'Learning to learn' is important as means of responding to new situations ina creative manner. The critical pedagogy needs to emphasize the processes of constructing knowledge. The effort should be to provide an 'opportunity

cognitive and aesthetic appreciation

PEDAGOGY

The etymology of the word pedagogy comes from the Greek w paidagogos, which means a slave who escorted children to school. Later word pedagogue refereed to a teacher, a person who leads a child. To es is to lead is to walk a child through a journey. Thus, there is a pedis (L word for foot) dimension to teaching or a pedalogical characteristic inhe in the pedagogical. Pedagogy would be the study of walking alongside student as a mentor or teacher. Using a pedagogical frame, one might what does it mean to walk, to stand, to stand tall, to stand up to, to stand is to stand with? And who are the people who walk beside this man?

CRITICAL PEDAGOGY (CP)

The perspectives of Paulo Freire's pedagogy make it clear that knowl alone does not transfer life. Only the conversion of knowledge into ac can transform the life. This concretely defines a dialectic mover between the conversion of transformative action into knowledge and conversion of knowledge into transformative action. The transformatio only changes life but also the subject, making these subjects free beings to think their individual and social praxis, articulating the local with global and extracting from life experiences and from the various knowl about life a strategic direction. Thus, it is a commitment to c encouraging and vibrant space and environment in learning. The co learning is to develop basic forms of understanding each of whic characterized by distinctive concepts, forms and processes of verifica validation and justification, knowledge creation and creativity. pedagogy concerns itself with the development of capacities of work action, forming and sustaining relationship. The ideology is viewe cognitively significant to view the world, to understand, to engage and t on it. Both explicit and articulated knowledge as well as tacit experiential knowledge, creativity and excellence are all integral to t forms of knowledge and knowing. It is therefore to organize lea experiences to empower 'learners' and 'transform learning'. By this n teaching and learning should give learners a greater sense of 'owners Thus, the notion of critical pedagogy is an 'empowering' and 'transform pedagogy.

To say empowering and transforming is based on the following questio

1. Empowering for whom and for what purpose?
2. To what extent transferring is directed?

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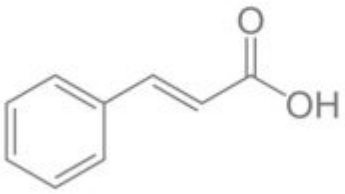

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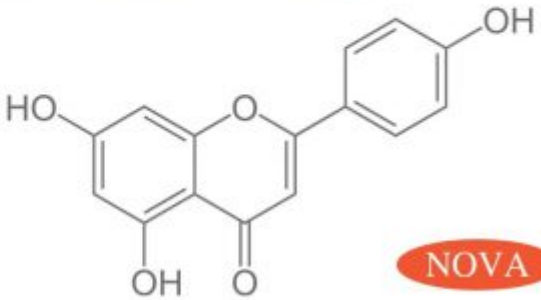

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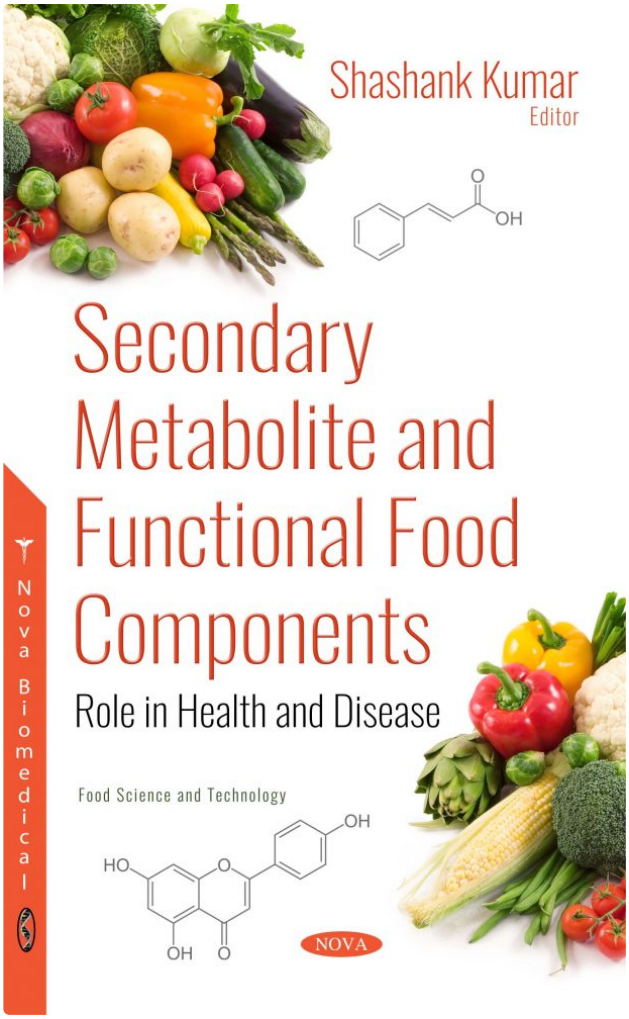

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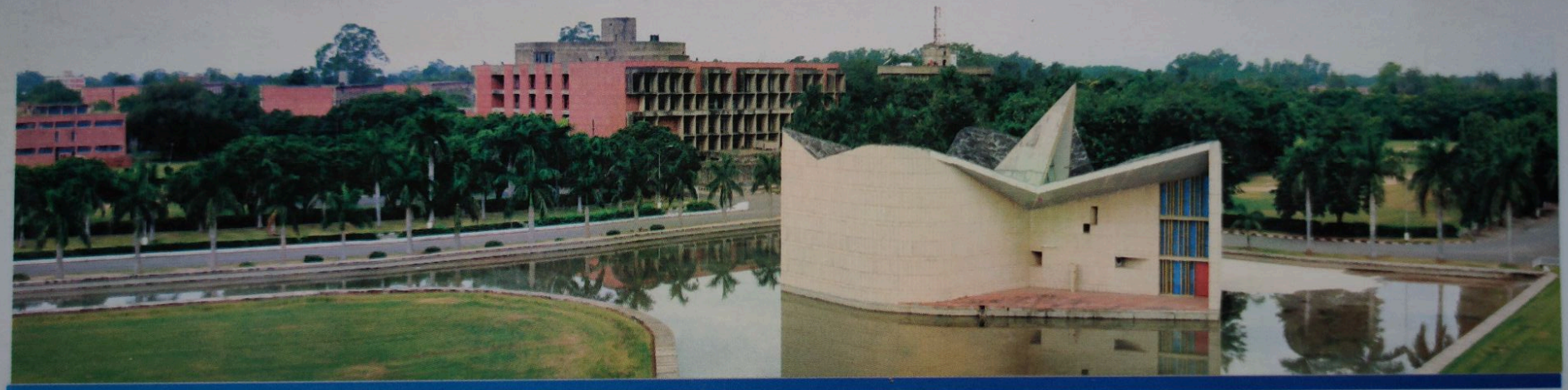

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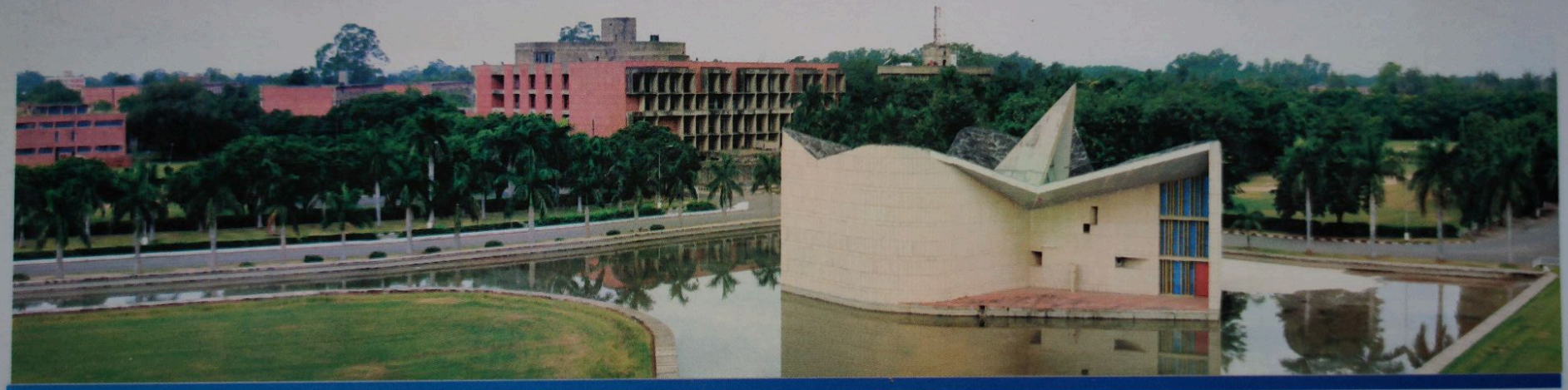

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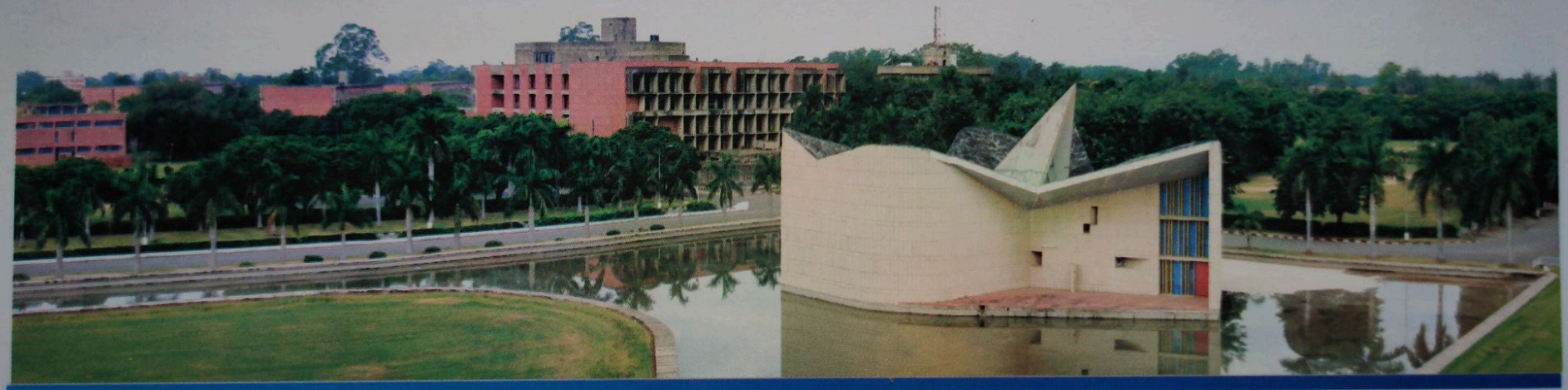

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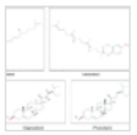

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Abstract

Virgin coconut oil (VCO) is the freshly obtained mature kernel of the coconut, by mechanical or natural means, with or without the use of heat and without undergoing chemical refining. When compared to copra coconut oil (CCO), marginal differences exist with respect to iodine value, saponification value, refractive index, fatty acid profile, specific gravity, and moisture content. VCO has many health benefits, such as preventing the oxidation of low density lipoprotein lipid increasing the antioxidant enzymes. Additionally, total polyphenol, antioxidant activity, tocopherol, phytosterol, monoglycerides, and diglyceride content in VCO samples are different from CCO samples. In vivo studies on Wistar albino rats prove that VCO samples are better in reducing hypercholesterimia and diabetes. VCO was found to be good frying oil in terms of stability and acceptability after 8 h of frying of soaked Bengal gram dhal. Blends of VCO were found to be stable for up to 12 months of storage in various flexible and rigid packaging systems, at varying temperatures. After VCO extraction, the resulting residual material obtained, termed as virgin coconut meal (VCM), has been used to make different traditional Indian sweets (ladoo & burfi) as well as baked goods (biscuit & cake).

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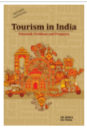

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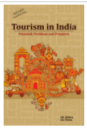

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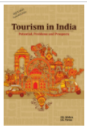

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Sudheer Singh Verma & Shantesh Kumar Singh

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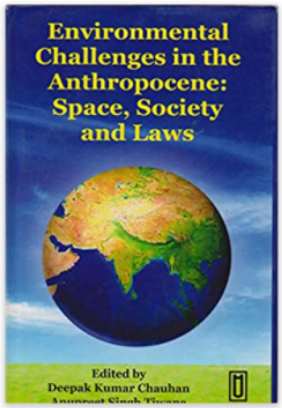

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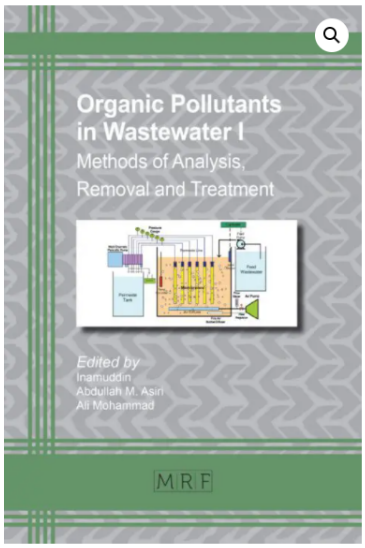

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Description

Use of Agricultural Solid Wastes as Adsorbents

S. Naga, A. Bhardwaja, P. Pandeya, M. Arorab, J.N. Babu

Biosorption through agricultural lignocellulosic wastes and by-products has been identified as a viable substitute to current technologies applied to remove toxic metal ion and organic pollutants from water and wastewater. The present study emphasizes the use of agricultural and agro-industries based residues as low-cost biosorbents. The study aims to revisit the status of biosorption and various recent advances made in this arena. Biomasses are the main focuse of this study which requires substantial management. Further, this is supplemented with the physicochemical processing of such biomasses and their application in adsorption. The surge in biomass to energy applications in recent years has resulted in charred biomass production as a residual. These biochars have been used as adsorbents. The biosorbents have been divided into the following three groups: (i) raw biomass, (ii) processed biomass and (iii) charred biomass. The affinity of sorbents in the removal of organic and inorganic pollutants and their applications on water and wastewater have also been studied.

Keywords
Agricultural Waste, Heavy Metals, Organic Contaminants, Biomass, Biochar

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Part of Organic Pollutants in Wastewater I

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Abstract

Population growth, urbanization, industrialization, intensification of agriculture and food production have considerably contributed to solid waste generation in recent times. To dispose this burgeoning solid waste, destructive techniques such as landfilling and incineration are used. These methods wipe out various nutrients present in the solid waste which otherwise can be recycled using other methods. Solid waste is heterogeneous in nature, and any single method is not sufficient for its management. But Non-toxic fraction of the solid wastes can be used as feedstock for various biological processes to recover or produce value-added products from solid wastes. Such biological processes include biomethanation, composting and vermicomposting. Among these, vermicomposting has been reported as a practicable, economical and swift technique for proficient management of the solid wastes. In this process, earthworms convert compostable fraction of the solid wastes into stabilized, finely divided peat-like material called vermicompost that can be used as manure in agricultural fields to improve soil health. Different waste residues like animal excreta, agricultural residues, domestic waste, sewage sludge, industrial wastes etc. have been used as earthworm feedstock in

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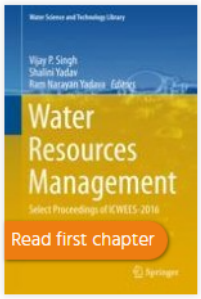

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Abstract

Punjab, an agricultural state of India, is facing a severe water crisis due to lesser annual rainfall than normal (700 mm) since 1998. Further, Punjab is not getting adequate amount of river water due to political reasons like Indus treaty, damming and diversion of river water, water conflict with Haryana, Rajasthan, and central government. However, the irrigation water demand (4.45 m ham) is significantly more than total irrigation water availability (3.04 m ham). Hence, in most parts of the Punjab state, groundwater is being overexploited for irrigational purpose. Apart from this water scarcity or depletion problem, water quality is also being deteriorated and not suitable for drinking purpose. Basic groundwater parameters such as salinity, electrical conductivity (EC), chloride (Cl^-), and nitrate (NO_3^-) have surpassed the maximum permissible limit in most of the parts of this state. Even toxic heavy metals [like selenium, uranium, arsenic, and lead] and pesticides have also been reported in groundwater samples of several regions of Punjab. Intake of this heavy metals and pesticides contaminated water is affecting the health of native people. The condition of groundwater depletion and quality deterioration is most severe in Malwa region of Punjab. The poor water quality and presence of toxic heavy metal may be linked with the prevailing health issues in this region. Government is taking several initiatives regarding this issue and passed the Punjab Preservation of Sub-Soil Water Act (2009). Government is also providing subsidy to individual farmer to lay down underground pipeline, drip and sprinklers systems for irrigation. Additionally, government is promoting and appreciating preventive measures like watershed management and rainwater harvesting.

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Constructivist Pedagogy: Vital for Meta Cognitive Reflection (MCR)

Dr. BiswajitBehera

Abstract

The core of learning is to develop basic forms of understanding which is characterized by forms and processes of verification, validation and justification, knowledge creation and creativity. Both explicit and articulated knowledge as well as tacit and experiential knowledge, creativity and excellence are all integral to the form of knowledge and knowing. It is therefore to organize learning experiences to empower 'learners' and 'transform learning'. Reflection is critical to learning and transfer; it means to be embedded in assessment. A related approach is to require learning to serve a Meta cognitive reflection (MCR). This strategy is the presentation of multiple perspectives to learners by providing multiple representations on the content because there is no single schema.Therefore,Constructivist pedagogycan become the medium for practices of reflection. Strategies like reflective lesson logs, reflective journal, self assessment questions, wait time and group processing which provide opportunities for use of Meta cognitive reflection are suggested.

Key words: Constructivist pedagogy, Reflection, Meta cognitive reflection (MCR)

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A Plea Towards Sustainable Tourism

Pooja Jaswal and Biswajit Behera***

INTRODUCTION

Tourism is a systematic industry involving a percentage of funds and prospective. Tourism is the composite of activities, services and industries that carries travel disbursement, involving transportation, lodgings, amusement, hospitality related facilities and unified structure. Tourism is not only related to economic activity of significance in as much as it produces foreign exchange for a country. It is a vital intermediate of social and cultural development. Late Prime Minster Jawaharlal Nehru said that "We must welcome friendly visitor from abroad not only for economic reasons but even more because this leads to greater understanding and mutual appreciation. In the long run, the most important contribution to tourism is developing understanding among varied cultures and life styles. Tourism has become the world's largest industry producing prosperity and occupation.

EMERGING SITUATION OF TOURISM IN INDIA

Tourism is one of the biggest-growing industries on earth and its hegemony appears secure if the current rate of growth is maintained. Tourism is one of the main sources of internal revenue generation.

Tourism is largest and fast growing industry in India. According to the WTTC (World travel and tourism council) India tourism industry generated 9.6 % GDP and providing 40K employment in 2015. In 2015 more than 7 million foreign tourist arrivals in India and increasing

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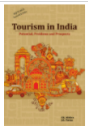

Tourism in India : Potential, Problems and Prospects

By P.K. Mishra , J.K. Verma

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ABOUT THE BOOK

In the 21st Century, tourism has emerged as a leading sector across the globe. This sector has been widely acknowledged for its contribution to national income, foreign exchange reserves, employment creation, business, poverty alleviation, infrastructure development, balanced regional development, cultural exchanges, and above all for developing and maintaining international relations and world peace. The developmen generates growth due to its linkage effects and cross-sectoral synergies which lead to the progress of other sectors including agriculture, handicrafts, healthcare, education, transport and communication, construction front, expansion of tourism brings positive changes in the population structure, occupational patterns, value system, individual behaviour, family relationships, collective lifestyles, moral conduct, creative expre ceremonies and community organizations.

In India, tourism has become the most vibrant service sector activity and a multi-billion dollar industry over the years. The natural surroundings, architectural masterpieces, music, dance, paintings, customs and l made India a tourist paradise. The strategies and policies of the Government of India including *Incredible India* and *Athithi Devo Bhava* have significantly contributed to the expansion of tourism in India.

The present volume contains 14 scholarly papers, authored by experts in the field, which not only provide an overview of the growth of tourism in India, but also give an analytical account of the problems and pro with it.

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