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Research Highlights

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SARS-CoV-2 AND COVID-19 PANDEMIC

*** THYAGARAJAN, S.P.**

Abstract

The year 2020 has been marked pandemic year with the onset of the sixth-largest pandemic, severe respiratory syndrome coronavirus 2 *(*SARS-CoV-2*)* in December 2019 at Wuhan, China. The global experts have warned people about emerging and re-emerging pandemics and had identified prevention as the foremost step. The high rate of transmission and reported causality among COVID-19 infected people indicates the infectious pathogenicity and virulence nature of the coronavirus. Despite remarkable clinical research, it is still challenging to approve an effective drug for COVID-19 considering patient safety as the priority while evaluating the benefit - risk balance. Hence, to control effectively with evolution proof therapy, it is essential to understand the biology of the coronavirus that cause COVID-19.

Introduction

Coronaviruses have created an arduous unpredicted journey in the post-modern world causing havoc in all aspects of life. The last eighteen years have seen an emergence of life-threatening pandemics caused by the coronaviruses which include SARS (2002-2003) and the Middle East respiratory syndrome (MERS, 2012 to the present; de wit *et al*., 2016) and the latest among these is Coronavirus Disease (COVID-19) identified in the year 2019 (Huang *et al*., 2020; Zhou *et al*., 2020; Zhu *et al*., 2020; Li *et al*., 2020; Wang *et al*., 2020). Despite the ultra-fast progressive developments in the diagnosis and treatments of coronaviruses, their emergence and re-emergence is the stark reminder for constant surveillance, prompt diagnosis, and robust research that paves a way forward to understand the basic biology of newly identified organisms and our susceptibilities to them. At the same time, it is of utmost importance to develop effective countermeasures to tackle the current pandemic situation (Fauci *et al*., 2020). Hence, with these objectives, the review article is presented to understand SARS-CoV-2 and COVID-19 Pandemic.

Coronavirus

Coronavirus has a broad host range that crosses the vertebral classes boundaries from Aves to Mammalia species (Damas *et al*., 2020). The International Committee on Taxonomy of Viruses (ICTV) has taxonomically classified and identified the casual etiologic agent of COVID-19 as SARS-CoV-2. It is classified under "realm *ribiovirias*, order-*nidovirales*, family-*coronaviridae*, species-*severe acute respiratory syndrome related coronavirus* and genus-*Betacoronavirus"*.

* Chancellor, Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore - 641 043

Coronaviruses are emerging and re-emerging pathogens in humans and animals. The common pathogenic human corona viruses includes HCoV-229E (alpha corona virus); HCoV-NL63 (alpha corona virus); HCoV-OC43 (beta coronavirus); HCoV-HKU1 (beta coronavirus) (Lau *et al*., 2015). The recent occurrences of coronavirus pandemics, MERS Co-V; SARS-CoV are reported to cross species barrier by zoonotic transfer and have emerged rapidly in humans through viral evolution. 2019-*nCoV* or SARS-CoV-2 is one such newly identified coronavirus that adds up to the era of pandemics.

SARS-CoV-2 and their broad host range

Bats are presumed to be the likely host reservoir of the emergent coronavirus based on the previous study reports on SARS-CoV (Zhou *et al*., 2020)[a] China's quintessence biodiversity of bats, their co-existence with different viruses and their proximity to humans are the determinants that identified bats as the potential host of SARS-CoV-2. Any virus, in general, could cross-species barrier based on four determinants that includes host cell availability for the viral entry, followed by permissiveness for their replication and allow completing their life cycle by weakening the host cell innate immunity and making it susceptible to the virus (Hulswit *et al*., 2016). The origin of the novel coronavirus (SARS-CoV-2) from the host, bats remains uncertain. It would have likely been jumped to humans from the intermediate animal host by cross-species transmission also remains unclear. Studies have shown mutations and thereby evolution in viral genomes would have facilitated the cross-species transmission. Evidential role of Civets in *SARS* transmission was confirmed when the first pandemic of SARS-CoV type was identified in 2004 (https://www.cidrap.umn.edu/news-perspective/2004/01/who-sees-more-evidence-civet-role-sars).

We are still not sure of whether any intermediate host is possibly involved in the transmit of SARS-CoV-2 to humans or is there no involvement of intermediate host (Jarvis, 2020). Hence, a knowledge gap still occurs about the origin of SARS-CoV-2 and its emergence ever since, an outbreak in late December 2019, Wuhan city, Hubei Province, China. Probable involvement of bat as primary host and pangolin as an intermediate host has been phylogenetically presumed due to close relativity of Spike protein (S1) of Pangolin Co-V gene sequence with SARS-CoV-2 rather than Bat *nCoV RaTG13* (Zhang *et al*., 2020).

Biology of SARS-CoV-2

Coronaviruses are large enveloped single-stranded RNA viruses that encompass an unusual strategy to accomplish complex gene expression pathway (Masters *et al*., 2006). These enveloped RNA viruses have a unique ribosome frame shifting process during genome translation, synthesis and assembly of progeny virions. The large genome of the coronavirus is packaged similarly to eukaryotic cells. The genome size of the *nCoV* / SARS-CoV-2 is found to be 29,891 bases (Zhou *et al*., 2020)[a].

It consist of a linear single stranded positive-sense RNA genome of ~30 kb (Manfredonia *et al*., 2020) At the genomic nucleotide level, it was approximately reported to have 79.6% similarity to SARS-CoV. Despite these great variations observed between the gene patterns of SARS-CoV and SARS-CoV-2 lesser nucleotide similarity of only about 72% was observed in the main host interacting surface glycoprotein protein, spike (S) protein (Zhang and Holmes, 2020).

Structure of Coronavirus - SARS-CoV-2

Coronaviruses are roughly spherical with an average diameter of 80–120 nm. The genome of all coronaviruses encode "five major open reading frames (ORFs), including a 5′ frameshifted polyprotein (ORF1a/ ORF1ab) and four canonical 3′ structural proteins, namely the spike (S), envelope (E), membrane (M) and nucleocapsid (N) proteins other than, some subgroup-specific accessory genes that are found interspersed among, or in some cases even overlapping the structural genes" (Ashour *et al*., 2020).

Each of the structural protein components in coronavirus plays an important role in the structure and viral replication cycle (Masters *et al*., 2006). The current knowledge

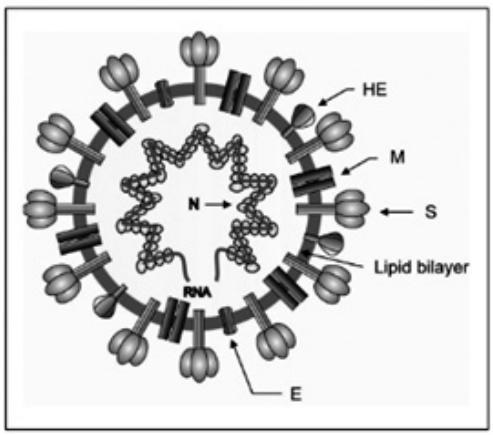

Fig 1.

Schematic Representation of Coronavirus

Membrane (M) and envelope (E) transmembrane proteins, the spike (S) glycoprotein projects haemagglutinin esterase (HE) (Source: Masters, 2006; de Wit *et al.,* 2016).

on the molecular biology of the coronavirus is extensively reviewed (Artika *et al*., 2020). The viral envelope of the coronavirus constitutes the major and minor structural proteins. The major structural proteins include Spike (S) and Membrane (M) protein. In addition to these, another major structural component hemagglutinin esterase (HE) is found in certain coronaviruses (Masters 2006; De wit *et al*., 2016). Along with these major proteins, a minor critical structural envelope protein component (E) is also

present. The spike (S) protein is a large glycosylated transmembrane protein and it plays an important role in the mediation of the virus attachment to the host cell receptors. It is an antigen that induces the host-specific immune response responsible for altered tropism observed in a different host and it is the prime focused target while designing the vaccine. The surface spikes of the coronaviruses protrude to about 17–20 nm from the surface of the virus particle and have been described as club-like, with a thin base that swells approximately to a width of 10 nm. The protein inside the envelope includes Nucleocapsid (N) protein and this binds to the viral genome. It's a phosphoprotein that plays an important role in packaging and stabilization of the virion particle. The other functions include its role in the replication cycle and modulation of host cell immune response (Masters, 2006).

All coronavirus genomes contain certain accessory genes interspersed among the canonical genes, replicase, S, E, M, N that varies in different coronaviruses. These are not essential for structure or replication but are mainly responsible for the pathogenicity and infection of the host (Michel *et al*., 2020). Protein-Protein interaction map (Gordon *et al*., 2020) characterized SARS-CoV-2 gene functions and 9 predicted accessory protein ORFs (3a, 3b, 6, 7a, 7b, 8, 9b, 9c, 10) as canonical structure of replicase [rep]-[S]-3a,3b [E]-[M]-6-7a,7b-8b-[N],9b,10 whereas the genome architecture with nanoball sequencing (Kim *et al*., 2020) revealed SARS-CoV-2 to contain only five predicted accessory ORFs as (3a, 6, 7a, 7b, 8) other than the common canonical genes.

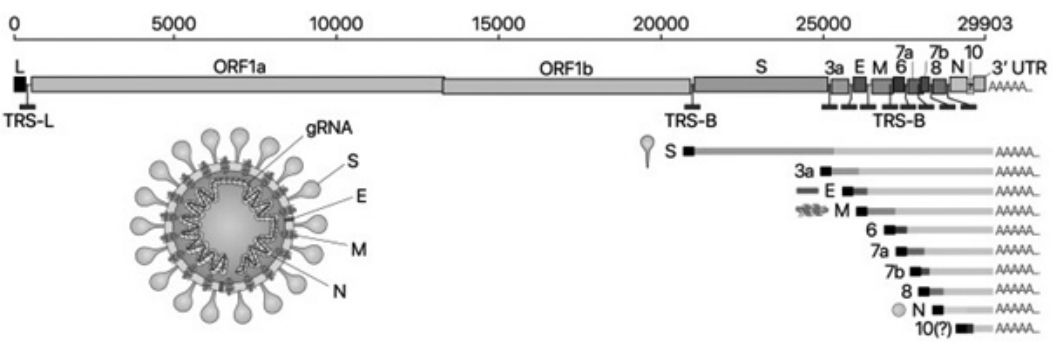

Fig 2.
Schematic representation of SARS-CoV-2 organisation (Source: Kim *et al*., 2020)

Pathogenesis of SARS-CoV

SARS-CoV-2 is a highly pathogenic virus (Zhou *et al*., 2020)[a] that recognizes the human angiotensin-converting enzyme 2, type I membrane receptor (ACE2) that is found in lung, heart, kidneys, and intestine. Two S protein trimers simultaneously bind to an ACE2 homodimer depicts the high-

resolution interaction complex (Yan *et al*., 2020).Virus makes entry in to the host cell through endocytosis process. This occurs by fusion of the spike protein of the viral envelope with the host cell membrane. After this, the virus releases its genomic RNA into host cell that gets replicated via replicase enzyme and transcribed and translated to synthesize viral protein and gets packaged and assembled in to virus. These packaged viruses get fused with the endoplasmic reticulum and golgi complex and are released through exocytosis process (Somasundaram *et al*., 2020). Thus assembly and budding of coronaviruses takes place at the junction point of endoplasmic reticulum-golgi component, indifferent to other enveloped viruses for which it takes place at the host cell plasma membrane. Hence, the nature of the coronavirus membrane envelope is characteristic of ERGIC complex (Ujike and Taguchi, 2015; Schoeman and Fielding, 2019).

The pathogenesis of SARS-CoV human infection remains ambiguous. However, reports claim for severity in infections due to combined viral replication in the lower respiratory tract with the involvement of an atypical immune response that can progress further to Acute Respiratory Distress Syndrome (de-wit *et al*., 2016). Thus emerging pandemic SARS Co-V 2 and MERS Co-V cause lower respiratory tract infection in contrast to other human coronaviruses viz., 229E, NL63, OC43, HKU1 that cause varying pathogenicity in upper respiratory infections with the common cold (Chen *et al*., 2020). Furthermore, the differences observed in epidemiological features, viral load, shredding time, and antibody dynamics between asymptomatic carriers and COVID-19 patients (Chen *et al*., 2020) in various countries raise further doubts about control measures followed for highly contagious coronavirus.

Viral Shedding

Viral shedding varies notably with the severity of the syndrome and its progression. Evidential virological assessment studies from hospitalized patients showed the average viral RNA load as 6.56 X 10^5 copies in whole naso and oropharyngeal swabs until day 5 with a maximum load of about 7.11 X 10^8 copies per swab (Wölfel *et al*., 2020). A high viral load noticed before disease onset suggests a high rate of transmission through pre-symptomatic patients. Hence, to manage the spread of infection, a minimum period of 14 days is essential to those who had or likely had COVID 19 (Kim *et al*., 2020). Moreover, SARS-CoV-2 live virus can remain in aerosols for three hours. Studies on viral stability and viability showed the half-life of SARS-CoV-2 almost like SARS-CoV-1 in aerosols, with central estimates of to 1.2 hour approximately within 95% credible intervals of 0.64 to 2.64 and 0.78 to 2.43 respectively for SARS-CoV-2 and SARS-CoV (Van-Doremalen *et al*., 2020). However, their SARS-CoV-2 RNA fragments can be found on inanimate surfaces for several days (up to 28 days) in hospital wards even after the discharge of COVID-19 patients, which insist on complete disinfectants usage to efficiently control the outbreak and manage their transmission of the nosocomial

infection (Zhou *et al*., 2020[b]). Biosafety level (BSL) guidance reports issued by centre for diseases Control and Prevention (CDC) recommends category 3 equipment (BSL-3) as safe to research on SARS-CoV-2 virus, whereas routine diagnostic specimens can use biosafety level 2 (BSL-2) equipment. (https://www.cdc.gov/coronavirus/2019-ncov/lab/lab-biosafety-guidelines.html). The limited information availability cautions world laboratories to take additional safety measures while assessing the risk associated with emergent coronavirus (WHO, 2004; BMBL, 2009).

Coronavirus and Immunity

Coronavirus infection associated protective immunity is short-lasting according to reports on seasonal coronaviruses. Hence, re-infections are most frequent when protective immunity is deficient presumably even for SARS-CoV-2 *(*Edridge *et al*., 2020). Supportive evidence of the rapid decline of anti SARS-CoV-2 IgG antibodies were observed in mild COVID-19 persons (Ibarrondo *et al*., 2020) and weaker immune response implications due to early convalescent phase (Long *et al*., 2020) adds on and raise further raise doubts and queries about protection through herd immunity and identified vaccine durability. With several countries detecting the new mutant coronavirus in spike protein, health authorities are raising eyebrows about repercussions of the emergency rolled out vaccines during the second wave of COVID-19 (https://www.bbc.com/news/science-environment-55404988). Hence, to manage the current situation, intense laboratory studies are underway to track the hopscotch of emerging viral variants across the globe.

Diagnosis of Coronavirus

Coronavirus presence is confirmed by qualitative diagnostic Real-time Reverse Transcriptase polymerase Chain reaction (rRT-PCR) test (Corman *et al*., 2020). It detects the presence of SARS-CoV-2 nucleic acid in both lower and upper respiratory tract specimens of various types. The cycle threshold value (Ct) of genetic markers of SARS-CoV-2 obtained in RT-PCR correlates with viral load. To some extent, Ct is also a proxy way to identify the likelihood of infectious transmission although its threshold value varies in several reports (Chitguppi, 2020). *In-vitro* SARS-CoV-2 Vero cell study observed infectivity at Ct value greater than 24 and symptom time to onset (STT) as less than 8 days (Bullard *et al*., 2020). In COVID-19 patients, Ct value above or equal to 34 confirms the non-viral shedding. However, few contradictory reports also claim viral shedding at less or more than reported threshold Ct value in COVID-19 individuals (Arons *et al.*, 2020; To *et al*., 2020). Thus the diagnostic ability of the RT-PCR is limited and it must be combined with patient history, other clinical observations and epidemiological history to take any clinical decisions. Nevertheless, RT-PCR is the most preferred test forCOVID -19.

Current Clinical Management Measures

The current clinical management of COVID-19 encompasses infection prevention, control safety measures and supportive care, including supplemental oxygen and mechanical ventilation. With no approved therapeutics so far, few repurposing of immunosuppressive drugs that could counteract the inflammation associated with the cytokine storm. These repurposed therapeutics gives early effective treatment and avert the progression of disease to serious and severe illness with causality. These measures pragmatic reduce the burden of the disease on the available health care systems.

Clinical Management in India

India followed the safety protective measures recommended by the World Health Organization. In addition to this, it also looked upon and contributed to knowledge gaps immediately with pragmatic containment measures using evidence-based medicines that dates back to ancient days. Hence, Ayurveda, Siddha and Unnai medications took the forefront in tackling the emergency pandemic outbreak situation by being more of prophylactic in action with integrated healthy lifestyle regimens. Hence, India has become a nutraceuticals market competitor of raw materials source's to the world market during the current pandemic burn-out.

A paradigm shift towards public intake of alternative natural phytocompounds opened up the need for multidisciplinary research perspectives. The Indian government is also looking forward in promoting interdisciplinary research with emphasis on purpose/mission-oriented research and development. The innovation and development is the backbone of a country, the Higher Educational Institutes must research COVID-19 from various interdisciplinary perspectives. The right-brained researchers and the academicians who could think out of the box and achieve short term research perspective with long term impact of pandemic management are the need of the hour.

The year 2020, ended fruitfully with a handful of clinically approved emergency vaccines and few others in trial stage. These emergency approved vaccines from global pharmaceutical companies includes, Pfizer/BioNTech, Moderna, Sinovac, Sinopharm, AstraZeneca as well as vaccine candidates from Zydus Cadila, Biological E, Novovax, Altimmune and the University of Saskatchewan and Indian companies such as Bharat Biotech. The real-time benefits of these candidate vaccine and emergency approved vaccine could be assessed only after their availability to the public.

Conclusion

Understanding the biology of the current pandemic is essential to develop well defined and approved COVID-19 protective measures. The re-emerging pandemic is demanding the research community from various domains of STEM, Humanities & Social Sciences and Arts to unite and find ways to overcome the pandemic as soon as possible. Moreover, the global community,

world experts and the funders are also setting priorities in COVID research for the build of new economical diagnostic devices, screening kits, treatment methods, therapeutic interventions and ways to tackle with the socio-economic and psychosocial consequences of a pandemic outbreak. The possible limitation of host immunity and vaccine due to emerging second wave caused by mutant viral strain cautions government, academia and the industry to identify, develop and implement the alternate potent safe bioactive phytoproducts against the crown virus. Thus, the future coronavirus outbreak control lies in how well and effective we develop long-lasting treatment strategies that could evade continuous infection from evolving coronaviruses.

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ESTIMATION OF NUTRIENTS AND PHYTOCHEMICALS PRESENT IN PEELS OF SELECTED VEGETABLES

*** SINDUSHA, M.S.**
**** THILAKAVATHY, S.**

Abstract

Vegetables peels are usually discarded due to their non-edible characteristics. This study was conducted to analyze the nutrient and phytochemical composition of the selected beetroot, plantain and sweet potato peels. These peels were found to be rich in nutrients. The tannin contents of the peels were also minimal. Other phytochemicals such as alkaloids, steroids, quinones, and flavanoids were also present in all the peels. Results from the present work revealed that these vegetable by-products are rich in nutrients and phytochemicals and can be used as natural sources for supplements.

Keywords: Vegetable, Peels, Nutrients, Minerals, Phytochemical, Phenol compounds, Tannins, Saponins, Quinones, alkaloids.

Introduction

Vegetables are rich source of essential micronutrients with immense health benefits and disease preventing potential that have remarkably increased their global consumption (Hassan-Pyar and Peh, 2018). They are consumed directly or processed into products (Romelle *et al*., 2016). On processing, it leads to accumulation of the agro or food wastes such as peels, skins, rinds seeds, stones, and oil-seed meals. It can cause serious environmental pollution, if not disposed properly due to their unpleasant odors, explosions and combustion, asphyxiation, and greenhouse gas emissions, (Chanda *et al*., 2010). Studies have confirmed vegetable wastes to contain good amount of valuable bioactive compounds such as phytochemicals, fibre, carotenoids, polyphenols, vitamins and minerals (Kumar *et al*., 2012; Khattak and Rahman, 2017). These vegetable peels produced as byproduct from food processing industry are frequently either fed to live stock or utilized as fertilizers. Instead, if found nutritious, these food or agro wastes, could be valorized into nutritous alternate form and added to foods to increase their value with the concept of zero waste cooking, an age old culinary practice. This concept maximally utilise each part of the food product to utilise the biaoactive components present even in food scraps such as vegetable peels.

In the current study, three vegetable peels were selected due to their higher rate of processing for consumption as packaged

* PG Student, Department of Food Science and Nutrition,Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore - 641 043

** Assistant Professor-SS, Department of Food Science and Nutrition, Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore - 641 043

snacks or drinks with huge food waste accumulation in south indian food processing industry. They include sweet potato peels, beetroot peel and plantain peel.

The peels obtained as byproduct from sweet potato (*Ipomoea batatas*) processing industry are considered as waste. In debate to this certain other study research reports also claims sweet potato peel as good source of proteins and antioxidants (Maloney *et al*., 2012), that could be recovered and used in the production of added-value products; or as base in the formation of enzyme (Pereira *et al*., 2017), lactic acids (Pagana *et al*., 2014), sugars and ethanol (Ojewumi *et al*., 2018) and biopolymeric film (Borah *et al*., 2017).

Another important vegetable waste that could be of use by waste valorization is beet root peel due to its high concentration of betalain and total phenols (Nemzer *et al*., 2011). Further, the main by product of the banana processing industry, plantain peel (*Musa paradisiaca*), was also chosen for the study as few reports claims for presence of essential nutrients such as total dietary fibre, vitamins minerals and antioxidants (Arun *et al*., 2015).

Hence, with this background the study was planned to estimate the nutrients, minerals and nutraceuticals present in the selected vegetable peels viz., sweet potato, beetroot, plantain.

Methodology

Collection and cleaning of selected vegetable peels

Peels of vegetables like beetroot, plantain and sweet potato were selected as they are usually discarded the most. Sweet potato was selected due to its high availability in the month of January-March. Plantain peels are discarded in every stage of its development due to its non-edible characteristics.

The collected vegetables were washed thoroughly 2-3 times with tap water followed by distilled water. They were all peeled using the same peeler, with none or little amount of pulp. Care was taken that the peels selected for analysis were undamaged. Hundred grams of the fruit and vegetable peels were taken and they were air and shade dried. After the peels were powdered. The weight of the sample before and after drying was noted.

Preparation of vegetable peel powder

The dried vegetable peels were powdered in a mixer. They were powdered until they achieved a consistency that resembled a slightly rougher texture otherwise grinding was continued for another 5 seconds to get the desired fineness. The powders were transferred into well cleaned and dried air-tight containers. The powders were stored in air-tight containers during storage to achieve maximum shelf life. This powder was used for phytochemicals and nutrient analysis. The quantity of dry powder obtained after drying was noted for 100g of fresh sample.

Determination of nutrients, minerals and phytochemicals

The moisture content was determined by drying sample (3g) in an air forced draft oven maintaining temperature at 105±5^{o}C. From the dry matter of the vegetable peel powder, the selected nutrients protein, fat, thiamine, riboflavin, ascorbic acid and beta-

carotene were analysed and expressed as concentration of nutrients present in 100 g of the dry peel powder in accordance with the methods outlined (AOAC, 1995). Further the determined nutrient contents of the vegetable peel were compared with their nutritive standard values of their corresponding pulp indicated in Indian Food Composition Table (NIN, 2017), to identify their nutrient benefits for consumption by zero waste cooking process.

The dried vegetable peel powder was analysed by wet digestion method using water and hydrochloric acid in the ratio (1:1v/v). The digested sample was cooled and diluted with double distilled deionised water in the ratio of 1:10 for further determination of the minerals such as calcium, phosphorous and iron by Atomic Absorbance Spectrophometer.

Extraction of the selected vegetable peels for the analysis of phytochemcials

The powdered vegetable peel (20g) was extracted in 200 ml of hydro-ethanol using maceration method. The dried vegetable peel powder was first soaked in the solvent for a period of 24-48 hours to allow maceration. The excess solvent was made to evaporate until thick gel-like slurry was formed. The dried crude concentrate extract was weighed to calculate the extractive yield and then transferred to glass vials (6×2 cm) and stored in a refrigerator (4°C), until used for analysis. Then, 0.1 gm and one gm of each sample were taken and diluted to 100 ml so that the concentration was one mg/ml and 10mg/ml. These diluted samples were used for preliminary analysis of phytochemicals.

Vegetable peels powder extracts were qualitatively screened for Carbohydrates (Molisch test), Protein (Millons test), Amino acids (Ninhydrin test), Alkaloids, Phenols (Wagners test), Flavonoids (Alkaline reagent test), Quinones (Sulphuric acid test), Cardiac glycosides (Keller Kelliani test), tannins (Braymers test), Saponins (Froth test), Steroids and terpenoids (Salkowski's test). The identified phytochemcials were further quantified by spectrophotometric methods specific for the phytochemicals., Phenols (Singleton and Rossi, *1965*), Alkaloids (Harborne, 1973), Flavonoids (Harborne, 1973), Tannins (Van-Burden and Robinson., 1981); Saponins (Hiai *et al*., 1976)

The study protocol was approved by Institutional Ethical Committee of Avinashilingam Institute with the approval number IHEC/18-19/FSN/09.

Statistics

Each experiment was repeated three times to obtain a reliable value. The mean of the triplicates was finally considered for further calculations. For comparison of the nutrients in between the three different vegetable peels, Analysis of Variance (ANOVA) with post-hoc test of LSD (Least significant Difference) was performed using statistical software package, SPSS version 20. The comparison of nutrients between fresh pulp and vegetable peel was done by calculating the simple difference value between the experimental mean value of peel nutrients and reported value of the corresponding vegetable pulp from Indian

Food Composition Table (NIN, 2017). Negative sign in the difference value observed among the different nutrients indicates their higher nutrient potential in comparison to the vegetable pulp.

Results and Discussion

Dry matter content of the selected Vegetable peels

The dry matter per cent of the selected vegetable peel are depicted (Table 1). It was understood that higher dry weight per cent was observed for beetroot vegetable peel followed by sweet potato and plantain peels. On pulverisation, of the beetroot vegetable peel, approximately about 1.6 per cent was lost whereas a reduction of about 0.6 per cent was noticed for plantain peel. Similarly a reduction of about1.4 per cent was observed for sweet potato vegetable peel.

Macro-nutrients and vitamins in the selected Vegetable peel powder

Table 1. Dry Weight Percent of the Vegetable Peels in Fresh, Dried and Powdered Form

Vegetable Peel	Dry Weight (%)	
	Dried	Powder
Beetroot	20.3	18.7
Plantain	10.5	9.6
Sweet potato	16.7	15.3

The nutrient content present in the vegetable peel are presented in Table 2.

Table 2. Selected nutrient Content of Vegetable Peels

Nutrients in 100g of dry peel powder	Dry Vegetable Peel			p value
	Beetroot peel Mean ± S.D	Plantain peel Mean ± S.D	Sweet potato peel Mean ± S.D	
Protein (g)ND	0.13 ± 0.01	0.6 ± 0.14	< 0.001*	
Total Fat (g)	2.3 ± 0.12	2.2 ± 0.06	11.8 ± 0.08	< 0.001*
Thiamine (mg)	0.02 ± 0.00	0.03 ± 0.01	0.02 ± 0.01	0.296
Riboflavin (mg)	0.04 ± 0.02	0.02 ± 0.01	0.02 ± 0.00	0.171
Ascorbic Acid (mg)	13 ± 0.32	39 ± 1.00	21.1 ± 0.21	< 0.001*
Beta-carotene (µg)	15.3 ± 0.06	6788 ± 1.53	8781 ± 0.85	< 0.001*

*Values are means of three replicates and their relative standard deviation, significant values ($p < 0.001$) are expressed for ANOVA, ND – Not detectable

It was understood from Table 2, that the selected vegetable peel, the macronutrient, protein was found to be significantly ($p<0.001$) highest in sweet potato peel followed by plantain peel**.** Beetroot peel was found to have non detectable levels of protein in contrast to their reported presence in the minimally processed beetroot waste flour (Costa *et al.,* 2017). The presence of protein in peel was also indicated on application of novel extraction techniques (Seremet *et al*., 2020). Nevertheless, their contrasting levels

must be further investigated for the variations among different cultivars and different extraction techniques**.** The interpretation of negligible presence is supportive of the fact that beetroot and its peel as a low protein source.The total fat content was found to be signifiantly higher in sweet potato peel at 1% level whereas the total fat content was found to be similar in the beet root and plantain peel**.**

The thiamine and riboflavin contents of the selected peels were found to be almost similar for all the selected vegetable peels**.** The ascorbic acid content was sigificantly higher ($p<0.001$) in plantain peel followed by sweet potato and beetroot peels. While sweet potato and plantain peels were found to have significantly higher ($p<0.001$**)** beta-carotene content and lower in beetroot peel (Table 2). In augement to this Arora *et al.* (2008) has reported banana peel as rich source of carotenoids and their variations in different cultivars.

Minerals in the selected vegetable peel powder

A highest mineral content was noted for plantain peel and sweet potato peel in comparison to the beet root peel (Table 3).

Table 3. Mineral contents in the Selected Vegetable peel

Minerals (in 100g of dry peel powder)	Dry Vegetable Peel			p value
	Beetroot peel Mean ± S.D	Plantain peel Mean ± S.D	Sweet potato peel Mean ± S.D	
Calcium (mg)	10.6 ± 0.06	120.3 ± 0.06	60.5 ± 0.49	< 0.001*
Iron (mg)	2.3 ± 0.12	2.2 ± 0.06	11.8 ± 0.08	< 0.001*
Phosphorous (mg)	0.02 ± 0.00	0.03 ± 0.01	0.02 ± 0.01	0.296^{ns}

*Values are means of three replicates and their relative standar deviation, significance values ($p < 0.001$) are expressed for ANOVA, ns denotes non significant values

Plantain peel was found to have the highest differences in the mean amounts of calcium, and iron than the other two peels that significantly varied at the level of $p<0.001$. The mineral content reported in the current study is different to reported levels (Aboul-Enein *et al.*, 2016). The level of phosphorus was found to be similar in all three selected vegetable peels as siginificant difference in their mean is indetectable. The iron and calcium contents were low. Sweet potato peel had high amounts of calcium and phosphorous.

Comparison of the nutrients of the Vegetable peel powder with pulp

The nutrients present in the selected vegetables peel and pulp are represented in (Table 4). It was found that the sweet potato peel on an average had the highest macro, micro nutrients and mineral content among the vegetable peels. The beetroot peel rather than pulp was found to have more nutrients and minerals except for the presence of proteins and calcium. Similarly plantain peel contains nutrients higher than their corresponding pulp excluding

the nutrients, protein and riboflavin. Hence, it could be concluded that vegetable peels are rich in most of nutrients than its pulp. Thus the increased nutrient variation observed in the vegetable peels shows the unexplored nutritive potential of the vegetable peels that creates sustainable considerations on the valorization of the organic waste.

Table 4. Comparison of Nutritive potenetial of vegetable peel and pulp

Nutrients (units /100 g of dried vegetable peel	Beetroot			Plantain			Sweet potato		
	Pulp*	Peel‡	d	Pulp*	Peel‡	d	Pulp*	Peel‡	d
Protein (g)	1.9	0	1.9	1.2	0.13	1.07	1.3	0.6	0.7
Fat (g)	0.1	2.3	-2.2	0.2	2.2	-2.0	0.3	11.8	-11.5
Thiamine (mg)	0.01	0.02	-0.01	0.01	0.03	-0.02	0.07	0.02	0.05
Riboflavin (mg)	0.01	0.04	-0.03	0.05	0.02	0.03	0.04	0.02	0.02
Ascorbic Acid (mg)	5.3	13	-7.7	23.2	39	-15.8	17.9	21.1	-3.2
Beta-carotene (µg)	12.9	15.3	-2.4	224	6788	-6564	8653	8781	-128
Calcium (mg)	17.3	10.6	6.7	13.8	120.3	-106.5	27.5	60.5	-33
Iron (mg)	0.8	7.6	-6.8	0.3	27	-26.7	0.4	6	-5.6
Phosphorous (mg)	36.3	173.8	-137.5	31.7	400	-368.3	43	151	-108

* Reported values from (NIN, 2007); ‡experimentaldata given for triplicate values, 'd' denotes the level of nutrient difference between pulp and peel, negative sign (-) indicates higher presence in peel than pulp

Phytochemcials in the selected vegetable peels

The qualitative phytochemical screening (Table 5) showed the selected vegetable peels to be abundant in phytochemcials such as alkaloids, phenols, flavonoids and tannins other than carbohydrates. In contrast to this steroids and terpenoids were found only in beet root and plantain peel. The phytochemicals viz., quinones and cardio glycosides were absent in beetroot peel other than proteins. Similarly saponins, steroids and terpenoids were not present in the sweet potato peel. The beetroot peel was shown to have high difference in their mean levels of phytochemcial content at 1% level of significance whereas the flavonoids and tannin content were observed to be higher in sweet potato peels. The least mean difference was observed in the levels of all study phytochemicals except for saponins.

Table 5. Qualitative Analysis of Phytochemicals in Vegetable Peels

Phytochemicals	Beetroot Peel	Plantain Peel	Sweet Potato Peel
Carbohydrates	++	+	+++
Protein and amino acids	-	+	++
Alkaloids	++	++	+++
Phenols	+++	+	++
Flavanoids	+	+	+++
Quinones	-	+	+
Cardiac Glycosides	-	+	+
Tannins	++	+	+++
Saponins	+	+	-
Steroids	++	++	-
Terpenoids	++	++	-

*data given for triplicate values, +denotes the presence of photochemical while '-' denotes the absence, increased number of mathematic symbol indicates the intensity of the phytochemical presence

Table 6. Quantitative Analysis of Phytochemicals in Vegetable Peels

Nutrients in 100g of dry peel powder	Beetroot Mean ± S.D	Plantain Mean ± S.D	Sweet Potato Mean ± S.D	p value
Alkaloid	1.97 ± 0.08	0.61 ± 0.05	1.92 ± 0.06	< 0.001*
Phenol	132.4 ± 1.2	1.59 ± 1.7	51.32 ± 0.01	< 0.001*
Flavanoids	4.3 ± 0.2	1.7 ± 0.1	17.1 ± 1.1	< 0.001*
Tannins	27 ± 0.7	4.1 ± 0.3	0.7 ± 0.02	< 0.001*
Saponins	1.1 ± 0.04	3.25 ± 0.12	nd	< 0.001*

*data given for triplicate values, significance values ($p < 0.001$) are expressed for ANOVA, nd- Not Detectable

Summary and Conclusion

Present study was conducted to explore the nutrient potential of vegetable peels. This study confirmed vegetable peel wastes to be a rich source of nutrients, minerals and bioactive phytochemicals or nutraceuticals. Hence, they can be extracted to be used in supplements. Thus valorization of the vegetable peels into value-based food or feed products for the societal well being is ultimately a reinvention of the zero-waste cooking process with an added economic value that leads to food security and sustainability.

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ANTAGONISTIC ACTIVITY OF *Aspergillus giganteus* AGAINST FILAMENTOUS FUNGAL PATHOGENS

*** RAMYA, R.**
**** KAVITHA, D.**

Abstract

Fungal infection becomes a global threat to the well being of human, animal and plants causing an increased rate of morbidity and mortality. In this context, Aspergillosis is an emerging fungal infection and its pathogenic progression leads to respiratory failure in patients. Their infection origin is still debatable of being nosocomial or community-acquired. Indeed, there is a demand for the natural antifungal compounds for the prevention of infections. The current study confirmed the antagonistic efficacy of the *Aspergillus giganteus culture* protein rich filtrates against aspergillosis causing human fungal pathogens namely, *Aspergillus fumigatus* and *Aspergillus flavus* which paves the way ahead towards the development of therapeutic antifungal compounds against Aspergillosis that are natural, economical, sustainable and effective with less toxicity.

Keywords: Antagonism, *Aspergillus fumigatus*, *Aspergillus giganteus*, *Aspergillus flavus*, MIC.

Introduction

Emerging fungal infection is considered as a big threat to human health and it contributes to major mortality rate in immune compromised individuals. Predominantly, the antifungal drugs, vaccines and chemotherapy have been deployed for the treatment of fungal infections (Roacha *et al*., 2017). Indeed, fungi has developed several resistance mechanisms including target site modification, expression of the efflux pumps and metabolic inactivation that results in the antimicrobial resistance which poses a major global concern, (Trebi, 2017). Aspergillosis is a respiratory disease in human caused by filamentous pathogens namely, *Aspergillus fumigatus* and *Aspergillus flavus* which quickly evades into the host. The origin of infection is still not understood of being nosocomial or community-acquired. Filamentous fungi are of great importance because they not only deteriorates human and plant health but some have potential to produce antifungal compounds. *Aspergillus giganteus* is an antagonistic fungus known to produce proteins or peptides that can be used to kill pathogenic filamentous and non-

***** Research Scholar, Department of Biochemistry, Biotechnology and Bioinformatics, School of Biosciences, Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore - 64 1 043.

** Assistant Professor, Department of Biochemistry, Biotechnology and Bioinformatics,School of Biosciences, Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore - 64 1 043.

filamentous fungi (Mary and Florl, 2011). The alternative strategy utilizing natural source for the production of antifungal compounds with less toxicity is of major global economic concern (Utesch *et al*., 2018; Galgozy *et al*., 2019). Hence, the current study has focused to understand the antagonistic potential of *Aspergillus giganteus* culture filtrates with the pathogenic fungus namely, *Aspergillus fumigatus* and *Aspergillus flavus*.

Methodology

Fungal strains and culture conditions

Aspergillus fumigatus and *Aspergillus flavus*, pathogenic strains were obtained from hospital in Coimbatore and the antagonistic fungi, *Aspergillus giganteus* (MTCC8408) which was procured from Microbial Type Culture Collection, Institute of Microbial Technology (IMTECH), Chandigarh. The fungal strains were maintained on Czapek Yeast Extract medium (CYE) at 4ºC for storage. Before applications the fungal strains were revived and subcultured on the same medium at 28 ± 2ºC in dark condition for 4-7 days.

Preparation of culture filtrates

The antagonistic fungal strain was cultured in a czapek yeast extract medium at 30°C with constant shaking at 170 rpm for 8 hours. Then the culture was incubated at 28 ± 2°C for 4-7 days. After incubation, the culture was collected and subjected to centrifugation at 10,000g at 4°C for 15 minutes. The supernatant was filtered through 0.22µm membrane filter to obtain culture filtrates. Finally, the culture filtrates was stored at 4°C before use. As of literature studies, the antifungal compounds in the *Aspergillus giganteus* is protein in nature (Vila *et* al., 2001; Tong *et* al., 2020). Hence, the protein content present in the culture filtrates was estimated by Lowry's method (Lowry *et al*., 1951).

Antagonistic activity of *Aspergillus giganteus*

The antifungal compounds produced from *Aspergillus giganteus* might be intracellular or extracellular. *Aspergillus giganteus* culture was centrifuged at 10000 rpm for 20 minutes. The supernatant was collected and then the pellet was washed twice with phosphate buffered saline. The pellet was resuspended in phosphate buffered saline. Then the cell free supernatant and pellet was tested for their antifungal activity against *Aspergillus fumigatus* and *Aspergillus flavus* by overlay assay. Briefly, 200µl of cell free supernatant and pellet of *Aspergillus giganteus* was poured onto the czapek yeast extract culture medium inoculated with the pathogenic strains. All the overlay assay plates were incubated at 28 ± 2°C for 4 days to observe the antagonism.

Overlay assay of culture filtrates in optimized culture condition

The pilot study in our laboratory has optimized the conditions for the growth of *Aspergillus giganteus*. The optimized growth conditions are given as follows: dextrose as carbon source, ammonium dihydrogen orthophosphate as nitrogen source, pH at 7 and temperature around 25ºC. The antagonistic activity of culture filtrates in the

optimized culture condition was carried out using overlay method. The hyphal interaction of pathogenic fungi with the antagonistic fungi in the inhibition plate was viewed under light microscope by performing hyphal interaction assay.

Hyphal interaction assay

The hyphae of fungal species play a key role in the infectious processes of any pathogen. The antagonistic zone in the test plate was stained using lactophenol cotton blue. The slides were observed under 40X magnification in a light microscope to check the hyphal interaction of pathogenic fungi with antagonistic culture filtrates.

Determination of Minimum Inhibitory Concentration (MIC)

Cultures of *Aspergillus fumigatus* and *Aspergillus flavus* were placed on czapek yeast extract agar and incubated for 24 to 72 hours at 28 ± 2^{o}C. Colonies of this culture was suspended in sterile 0.85% sodium chloride. Czapek yeast extract broth containing culture filtrates at different concentrations such as 500µg, 250µg, 125µg, 62.5µg and 31.25µg were added to a 96 well plates. The plates were incubated at 28 ± 2^{o}C for 24 to 48 hours. Minimum Inhibitory Concentration (MIC) was determined by adding 20µl of 0.5% triphenyl tetrazolium chloride to each well and then the plate was further incubated for 24 hours. MIC are defined as the lowest antimicrobial compounds concentration that inhibits visible growth of the microorganism.

Minimum Fungicidal Concentration (MFC)

The culture from wells without visible growth were seeded on plates containing czapek yeast extract agar, which were then incubated at 28±2^{o}C for 24 to 48 hours for the determination of minimum fungicidal concentration. MFC is considered as the minimum concentration of antifungal compounds that exhibit nearly 98 to 99.9% of killing effect on pathogens.

Statistical Analysis

All the experiments were carried out in triplicates and the values are expressed as mean ± SD. Unpaired t-test was used to compare the anatagonistic potential exhbited by the individual culture filtrates or culture pellet of *A.giganteus* on the test pathogenic fungal species *A.fumigatus* and *A.flavus*. Also a paired-t test was performed to compare the antagonistic effect of antifungal culture filtrates and pellet on pathogenic fungal test species.

Results and Discussion

Antagonistic activity of ***Aspergillus giganteus***

The antifungal compounds are efficient in treating fungal diseases caused by pathogens. The per cent inhibition of the supernatant and pellet of *Aspergillus giganteus* is represented in Fig 1. The supernatant of the *A.giganteus* exhbited maximum antagonism against the respective pathogenic cultures of *Aspergillus fumigatus* and *Aspergillus flavus* to about 90.3 ± 1.3 and 84.6 ± 4.04 per cent, whereas in the pellet, the activity in terms of percentage of inhibition was found to be 23.6 ± 1.2 and 30.8 ± 6.3, respectively. That is there were no significant differences observed between the mean levels of

inhibitory potential of the *A.giganteus* culture filterate or the pellet ($p > 0.05$) against both the opportunistic fungal species of *A.fumigatus* and *A.flavus*. Conversely the anatagonistic inhibitory potential of the *A.giganteus* culture pellet was approximately three fouth and significantly lesser ($p < 0.05$) than that of the culture supernatant (Fig. 1). Thus, the current study showed the antagonistic potential of the anti-fungal compounds to be more superior in the supernatant than the pellet. Also, their extracellular presence with a protein concentration at 0.5 mg/ml is confirmed.

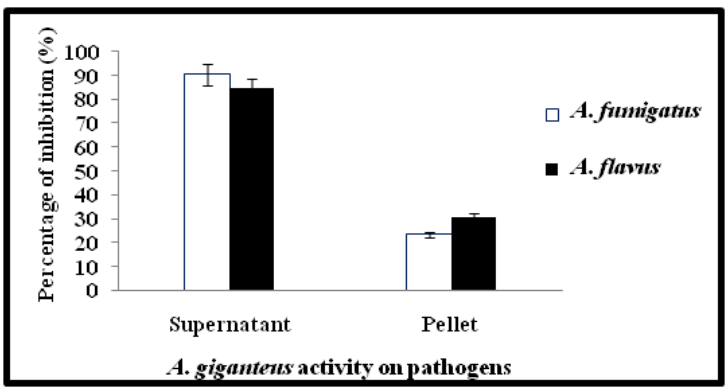

Fig. 1
Antagonistic activity of supernatant and pellets from *Aspergillus giganteus* on *Aspergillus fumigatus* and *Aspergillus flavus*

Antagonistic efficacy of ***A.giganteus*** culture filtrates

Hyphae, a complicated morphological feature on adherence and penetration into the host leads to the disease and its progression. Thus, human fungal pathogen with extensive hyphal growth indicates their virulence. Hence, with the hyphal interaction assay, the anatagonistic potency of the culture filtrates of *Aspergillus giganteus* on pathogenic fungi were confirmed visually through microscopic examination of the hyphal interaction (Plate 2). The results have shown that the pathogenic fungi., *A. fumigatus* and *A. flavus* in the absence of culture filtrates overlay displayed well defined morphology and extended hyphal networks, whereas the culture filtrates treated pathogenic fungi cultures of both the test pathogen showed reduction in hyphal growth.Thus, it was proved that the antifungal protenacious rich filtrates of *A.giganteus* acts as antagonist by inhibiting the hyphal growth and elongation. Thus, they regulate the pathogenic fungal organism by altering the mechanism of hyphal growth. Hence, their inhibitory efficacy of culture filtrates of *Aspergillus giganteus* was confirmed *in-vitro* by overlay of culture filterate on the pathogenic fungal cultures grown in their optimal conditions.

Previous reports from our laboratory had already confirmed the antagonistic efficacy of *A.giganteus* as a bio-control agent against aflatoxigenic *Aspergillus flavus* infecting maize (Krishnamurthy *et al*., 2020). The current study claims for possible therapeutic effect of *A.giganteus* against Aspergillosis

Minimum Inhibitory Concentration (MIC) and MFC of the *A.giganteus* Culture Filtrates

The therapeutic concentration of these antifungal proteinacious rich compounds were determined to understand the minimal concentration of the antifungal filtrate to which the pathogenic fungal cultures of *A.fumigatus* and *A.flavus* are susceptible. From the results, the MIC was found to be 125µg of antifungal compounds in the culture filtrates of *Aspergillus giganteus* for *Aspergillus fumigatus* and *Aspergillus flavus*. The MIC concentration of the *A.giganteus* filterate below this range up to about 31.25 µg/ml did not show any therapeutic response to both the pathogenic fungal cultures. Certain reports also claim MFC to be a better therapeutic indicator than MIC in determination of the therapeutic response of an antifungal compound. In the current study MFC of the antifungal protein rich filtrates was found to be about 250 µg/ml for both the test pathogens.

Table 2. MIC of A.giganteus filtrates against pathogenic test fungus

Test Fungal Organism	MIC (µg/ml)	MFC (µg/ml)
A.fumigatus	≥ 125	250
A.flavus	≥ 125	250

Summary and Conclusion

The protein rich culture filtrates of the *Aspergillus giganteus* exhibited effective antagonistic activity on the opportunistic fungal pathogens namely, *Aspergillus fumigatus* and *Aspergillus flavus*. The present work exploits the principle of fungal inter species competitive interference to develop therapeutic anatagonistic antifungal compounds from fungi. However, further purification and characterization of these filtrates are essential to develop therapeutic efficacious antifungal drugs that could effectively treat and manage Aspergillosis.

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ASSESSMENT OF PACKAGING FEASIBILITY OF A NOVEL BIODEGRADABLE FILM FROM FINGER MILLET STARCH

*** YAMEICHON RIMAI**
**** KARTHIGA, S.**

Abstract

Developing eco-friendly starch based polymer films; a promising alternative to synthetic polymers is preferred in the global food package industry due to its sustainable benefits of abundance, biodegradation and being economical cost-wise. As a contribution to this, bio-degradable film was casted with various proportions of finger millet starch, corn starch, plasticizer (glycerol) and the natural stabilizers (guar gum and chia seeds). These were then screened for its suitability as packaging material. The composition of amylose and amylopectin to about 21.8 per cent and 78.2 per cent from the total 30 per cent yield of the finger millet starch contributes to the homogenous and gelatinized structure. Among the different bio-degradable film composition variants studied, FCV1 variant that constitutes finger millet starch and corn starch in the ratio 1:1 was reported to be the most desirable packaging bio-film with 50% solubility and tensile strength of 7.78Mpa

Introduction

Environmental conservation is an act of responsibility concerning both the consumers and industries. The deposition of solid waste has become a great burden on the sustainability of the environment. One of the major concerns is the production of synthetic plastic which is tremendously used in the food industry for food packaging. Disposal of synthetic plastics create a great threat to the environment as it is not degradable by nature and may take up to 1000 years to get decomposed (Malathi, 2014). Considering the effect of synthetic plastic on the environment, new alternatives are being developed to maintain sustainability. One such is the production of degradable plastics, which can be disposed off and decomposed (Ezeoha and Ezenwanne, 2013).

Biopolymers have been used in the production of packaging materials such as trash bags, film wrapping, laminated papers, loose fill foam, food containers, hygiene products (diaper back sheets, cotton swabs), consumer goods (fast food tableware, containers, razor handles, toys), and agricultural tools (mulch films, planters), (Ramesh *et al*., 2010). Biodegradable films can be made from protein polymers Zein, a

* PG Student, Department, of Food Service Management and Dietetics, Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore – 641043.

** Assistant Professor, Department of Food Service Management and Dietetics, Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore – 641043.

prolamin protein found in corn, wheat gluten films from wheat flour, lipid substances like paraffin wax and bees wax, and polysaccharide based films which include cereal starches. Another starch rich plant source which is less exploited is millet starch. Considering the abundant availability of finger millet in India, the study was undertaken to identify the feasibility of the extracted finger millet starch or their mixture with corn starch in various proportions as a suitable food packaging material. A novelty was researched by the incorporation of natural stabilizers of guar gum and chia seed mucilage into the preparation of biodegradable food packaging film.

Methodology

Procurement of Raw Materials

Finger millet (*Eleusine coracana*), Corn (*Zea mays*) starch, Chia seeds (*Salvia hispanica*) and Guar gum (*Cyamopsis tetragonoloba*) powder were procured from local market in Coimbatore. The raw ingredients were purchased in bulk and the same was used for all procedures throughout the research. The chemicals used namely glycerol and acetic acid were of laboratory grade (LR) made by Merck Life Science Pvt. Ltd.

Extraction of Finger Millet Starch

Finger millet (500 g) was cleaned from grit and was pre-soaked overnight in water at the ratio of 1:1. It was made into a fine paste by grinding and filtered with mesh to extract its milk. The process was repeated until the complete milk was extracted. The extracted fine milk was kept undisturbed for 24 hours at 4^{o}C to remove the settled starch. The supernatant was drained off and the starch rich pellet was transferred to a steel plate and allowed to dry. Later it was scrapped off, powdered and sieved to obtain the fine pure finger millet starch. It was stored in air tight container for preparation of bio-film (Fig.1).

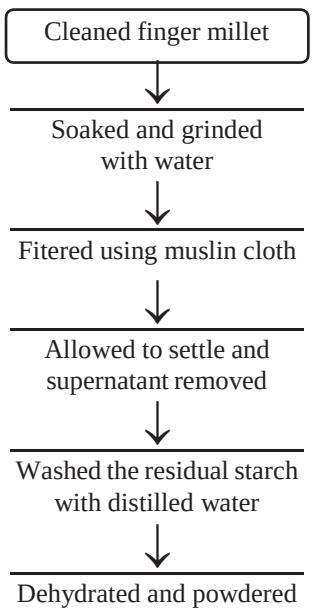


Fig. 1
Extraction of Finger Millet Starch

Analysis of Amylose and Amylopectin Content

The extracted finger millet starch was analyzed for the ratio of amylose and amylopectin as the total starch content influences the formation of biodegradable film. The amylose content present in the total finger millet starch was determined by colorimetric measurement at 625 nm with corn starch constituting 27% amylose as

standard (Williams *et al*., 1970). Amylopectin in finger millet starch was computed by subtracting amylose per cent from 100 per cent of total starch.

Natural stabilizers and their processing method

The natural stabilizers were used for the gel casting process. It includes guar gum powder and Chia seeds. Guar gum and chia seeds are selected as natural stabilizers for this research. Guar gum and chia seeds are not only rich in dietary fibre but also have antioxidant property making them potent natural stabilizers for production of biodegradable plastics and film. Guar gum was used in their powder form, whereas chia seeds were pre-processed to obtain the mucilage. The chia seeds mucilage was extracted by hydration with water at 1:20 ratio at room temperature for 50 minutes. The hydrated seeds were later centrifuged at 6600g for about 90 minutes to separate the mucilage from the middle layer (Brutsch *et al*., 2019) discarding the pellet and supernatant. The mucilage separated was used as stabilizer.

Biodegradable film composition

Three experimental variations in the stabilizers of the gel composites of biodegradable film were done to assess the change in thickness of the bio-degradable film (Table 1). The ratio of the finger millet starch, plasticizer and stabilizer was fixed to be at 5:0.9:0.3. An another composite of the biodegradable film was also assessed for the thickness, whereby 1:1 ratio of Finger millet starch and corn Starch was mixed together with 0.9 ml of stabilizer and 0.3 ml of stabilizer.

Table 1. Variations of Ingredients in the Preparation of Biodegradable Film

Variation code	FMS (g)	Corn starch (g)	Glycerol (ml)	Stabilizers		
				Acetic acid (ml)	Guar gum powder (g)	Chia seed mucilage (g)
FV1	5		0.9	0.3	-	-
FV2	5		0.9	-	0.3	-
FV3	5		0.9	-	-	0.3
FCV1	2.5	2.5	0.9	0.3	-	-
FCV2	2.5	2.5	0.9	-	0.3	-
FCV3	2.5	2.5	0.9	-	-	0.3

Gel Casting and Biodegradable film preparation

The gel casting was done in accordance to Jirukkakul (2016) procedure. About 5 g of the finger millet starch or its fifty per cent equal ratio with corn starch (2.5:2.5) with 0.9 ml of selected stabilizer (0.9) and 0.3 ml of one stabilizer variant (0.3 ml) was stirred and heated in a magnetic stirrer hot plate at 85^{o}C for 10 minutes until a gelatnization

begins. After removing from the heat, the solution was filtered to remove impurities and immediately casted on different petri plate immediately based on their composition ratio varying from FV1 to FCV1. Each of these petri plate with different composition variants from FV1 to FCV1 solution were put in a hot air oven and allowed to dry for 5 hours at 60^0C (Prabha *et al*., 2017). After complete drying, the petri plate was removed from the hot air oven and allowed to cool. The film was then peeled off and tested for various film properties.

Determination of Physical Property of Finger Millet Starch Based Biodegradable Film

Physical properties namely the color of the bio-degradable film and the thickness was performed visually other than the solubility and tensile strength determination.

Test for Water Solubility

Solubility of the bio-film was tested by following the method as reported by Romero-Bastida *et al.*, (2005). The prepared bio-film of size 2×3 cm was immersed in distilled water (80 ml) for 30 minutes at 25^oC, with constant stirring. After filtering with Whatman No.1 filter paper the bio-film remains were dried at 60^oC in oven until a constant weight is achieved. The solubility of the film was determined as change in the percentage of dry weight of bio-film both before and after soaking using the formulae: Solubility(%) = $(W_i - W_0) / W_i \times 100$; Where W_i is the initial dry weight and W_0 is final dry weight.

Determination of Tensile Strength

Tensile strength is the maximum force applied to a cross sectional area of a sample. It is an important property of biodegradable films as it indicates the ability to accept load or tension with breaking the composition which determine its applicability in food packaging. The mechanical strength of the film was determined using a tensometer **(Model :**Zwick and Roell, 2005). The bio-film variants of dimension 3 x 1 cm with relative humidity condition of 65%, at 21^oC, with a pre load of 0.1 Newton. The traverse rate was maintained at 10mm/min. The bio-film quadruplicates of each variant were assessed for their mean tensile strength and elongation at break of the films.

Statistics

The mean physical property of the bio-film and the standard deviation was calculated using Microsoft Excel 2010. The bio-film quadruplicates of each variant were used to study the mean tensile strength parameters.

Results and Discussion

Finger Millet Starch Yield, Amylose and Amylopectin Ratio

About 30 per cent of Finger millet starch (FMS) was the yield from the extracted finger millet milk using our procedure of wet method of starch extraction. The lesser yield of finger millet starch might be due to variation in the extraction procedure followed. The losses may have occurred during any step in starch separation process starting from extraction to isolation or during gel casting process or during the gel drying process. Despite the lesser yield, the texture of the isolated finger millet starch seemed to be a fine powder, dull white in color. FMS was found to constitute

approximately about 22 per cent of amylose whereas more than three quarter percent of the total starch was found to be amylopectin (Fig.2).

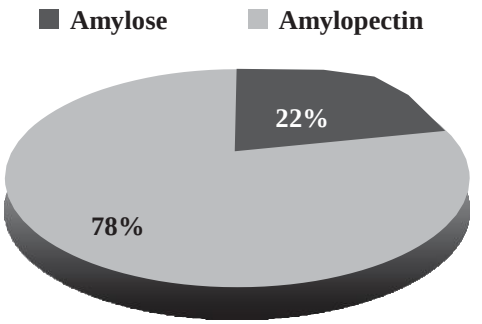


Fig. 2
Amylose and Amylopectin content of Finger Millet Starch

The concentration of amylose and amylopectin of FMS was found to be lesser than reported values for various other major cereals, Eiman *et al*. (2015); Vivek *et al*. (2018). However, the FMS amylose content was found to be in good agreement with cassava (http://www.fao.org/3/j1255e/j1255e04.htm) and potato amylose per cent (Jansky & Fajardo, (2014)). The differences in the ratio of amylose and amylopectin could also be contributed to variations in the starch extraction procedures and the determination methods or differences in botanical source plant or their variety (Marichelvam *et al*., 2019). Thus the ratio of amylose and amylopectin, the starch native components makes finger millet starch suitable for the bio-film formulation by further treatments. The respective bio-film strength and viscosity is mainly determined by the ratio of amylose and amylo-pectin composition of the extracted finger millet starch.

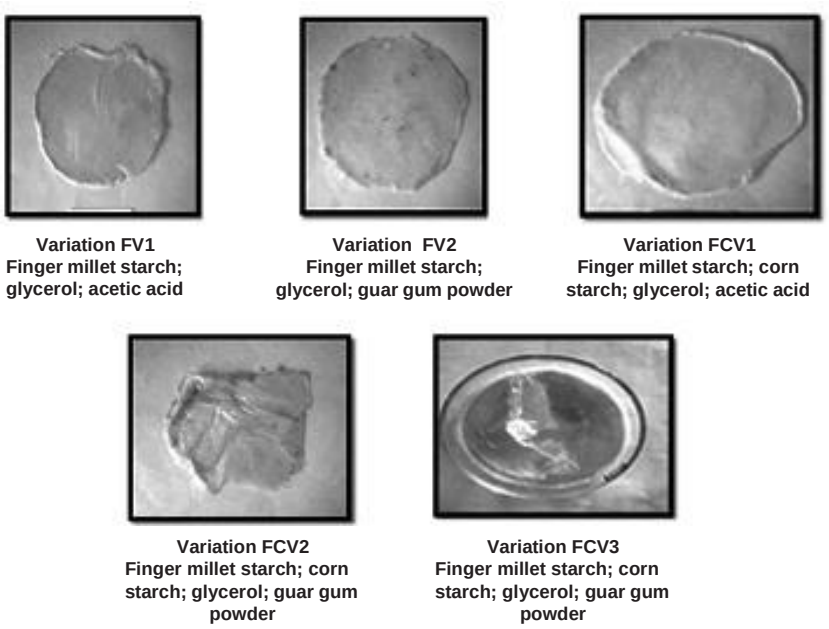
Physical Characteristics of Finger Millet Starch Based Biodegradable film

Color and thickness of the Biodegradable film

The biodegradable finger millet film variants FV1 to FV3 formed an off white film solution due to the dull white color of the isolated finger millet starch and guar gum powder while biodegradable film variant mix of finger millet starch with corn starch produced clear white film except FCV2. The dull color of the biodegradable film variant FCV2 might be due to the addition of 0.3 g of guar gum, a dull white powder. The plasticity of the finger millet based biodegradable film was maintained consistent using the plasticizer glycerol. The change in the ingredient (*i.e*) stabilizer influences the thickness of the finger millet based biodegradable film. Visually the film variants FV2, FCV2 formed the most hardened and thicker film among the different study biodegradable film variants due to the presence of guar gum powder in their film composition. The biodegradable film variants FV1, FCV1 exhibited a lesser thickness than the previous due to the addition of acetic acid into their composition. The biodegradable film was the least hard film due to the presence of chia seeds mucilage in their composition (FV3, FCV3).

Among the six biodegradable film study variants only FV1 (finger millet starch:glycerol:acetic acid), FV2 (finger millet starch: glycerol: guar gum powder), FCV1

(finger millet starch: corn starch: glycerol: acetic acid) and FCV2 (finger millet starch: corn starch: glycerol: guar gum powder) showed a stable film formation while casting on a petri dish, that was easily peelable at ambient temperature (Fig. 3). Thus, variants with good film stability were further selected to study the physical properties of the film. The bio-film variants., FV3 and FCV3, show weak film stability due to the weak porosity formed while adding the chia seeds mucilage. Thus our study results were contradictory to reports by Vieira *et al.*, 2011 that states successful bio-film formation with chia seed mucilage in combination with glycerol. Hence this concludes that stabilization property of the chia seed mucilage is not reliable for bio-film development.



Variation FV1
Finger millet starch; glycerol; acetic acid

Variation FV2
Finger millet starch; glycerol; guar gum powder

Variation FCV1
Finger millet starch; corn starch; glycerol; acetic acid

Variation FCV2
Finger millet starch; corn starch; glycerol; guar gum powder

Variation FCV3
Finger millet starch; corn starch; glycerol; guar gum powder

Fig. 3
Selected Stable Finger Millet Based Biodegradable Film Variants

Solubility of the Film

The biodegradable film variant FCV1 showed great stability (Table. 2) in comparison to other variant composites while casting and peeling of gel. The water solubility of the FCV1 variant, a combination of finger millet and corn starch variant was least in the range of about only 50 percent whereas FCV2 was 100 per cent soluble in water. Among the finger millet starch based biodegradable variants, FV1 and FV2 was found to exhibit solubility in the range of 57 per cent to 80 per cent. The lesser solubility and hence greater stability of the biodegradable film variants (FCV1 and FV1) might be due to the equal proportion mix of corn starch with finger millet starch and addition of acetic acid as stabilizer.

The reduced solubility of the FCV1 might be due to the enhanced starch polymerization with high amylose content on addition of corn starch to finger millet starch. Conversely the higher solubility and lesser stability of the biodegradable variants (FV2, FCV2) were due to usage of guar gum as stabilizers in the biodegradable film composition. Guar gum in general have high hydration potential and hence would had disrupted the starch bond and their cohesiveness with increase in the solubility rate of the biodegradable film variants in accordance to previous reports (Basiak *et al*. 2018).

Thus, FCV1 biodegradable film variant with equal proportion of corn starch mix with finger millet starch and use of acetic acid as stabilizer is preferable to prepare biodegradable food packaging film of enhanced structural and functional properties with exactly solubility rate at 50 per cent. The biodegradable film variant FV1 was also preferable to a lesser extent than FCV1 with solubility rate greater than 50 per cent. Conversely, the high soluble films variants (FV2, FCV2) are desirable to prepare edible films rather than packaging films due to their easy solubility.

Previous starch based biodegradable film formation from cereals, Daniel *et al*. (2019); Basiak *et al*. (2018) claimed for about 32 to 35 per cent with wheat and rice starch respectively. Comparitively the solubility of the finger millet starch based biodegradable film variants must be decreased to the order of cereal starch before commercialization by varying the composition of stabilizers, plasticizer or thickeners.

Table 2. Solubility of the Dry Film

Biodegradable film variants	Initial dry Wt of film (W_i) (g)	Final dry Wt of film (W_0) (g)	Solubility (%)
FV1	0.07	0.03	57
FV2	0.049	0.01	80
FCV 1	0.06	0.03	50
FCV2	0.045	0.00	100

Tensile Strength of the Film

The mechanical properties of the two selected variations FV1 and FCV1 which had a less solubility percentage are presented in Table 3. The mean breaking strength of the biodegradable film variant FCV1 was found to be higher than that of FV1. Thus FCV1 bio-film variant showed greater tensile strength with lesser value of elongation at break that might be due to the addition of corn starch, which has higher amylose content.

Several reports, Bonilla *et al*. (2013); Tavarasa *et al*. (2019); Domene-Lo'pez *et al*. (2019); Li *et al*. (2011) had confirmed that the mechanical properties of biodegradable films are influenced by the amylose content of starch due to variations in the composites molecular weight, film thickness, chain interaction and stretchability. The increased stiffness and the toughness of the FCV1 bio-film variant might be due to the increased amylose content on addition of corn starch to finger millet starch composition. Moreover the stronger intermolecular bonds thus formed in the FCV1 variant had not been disrupted by the plasticizer and hence, decrease in the chain mobility of FCV1 variant which is in accordance to Jantrawu *et al*. (2017).

Basiak *et al*. (2018) states that in accordance with the conventional standards, the ideal tensile strength for packaging films should be more than 3.5 Mpa. Hence, the reported tensile strength (Table 3) of the finger millet based biodegradable film variants FCV1 and FV1 are said to be within the standards making it suitable for food packaging material despite their differences in water solubility. Thus, millet based biodegradable film were superior to cereal based starch bio-film with higher tensile strength and lesser elongation break making it more preferable for food packaging.

Thus it is known that variation FV1 with lesser tensile strength is more stretchable and flexible than variation FCV1 of greater tensile strength.

Table 3. Tensile Strength and Elongation Break of Film

Bio-film variant	F_{max} (N)	dL at F_{max} (%)	Mean breaking strength F_{max} (N)	Tensile strength (Mpa)	Mean elongation dL at F_{max} (dL) (%)
	3.01	44.8			
FV1	2.43	44.6	3.11	6.22	33.5
	3.20	18.1			
	3.80	26.4			
	4.48	20.9			
FCV1	3.64	14.9	3.83	7.78	17.6
	3.28	16.0			
	3.92	18.8			

Summary and Conclusion

Considering the above results for various parameters, it is evident that biodegradable film variant FCV1 and FV1 have desirable property to prepare a biodegradable film with nearly 50 per cent solubility and a tensile strength of 7.78 Mpa and 6.22 Mpa respectively. They can be used as a potential protective wrap cover for fruits and vegetable slices to maintain their shelf life.

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GROWTH OF GROSS DOMESTIC PRODUCT AND MONEY SUPPLY IN INDIA - A COMPARATIVE STUDY BETWEEN PRE AND POST REFORM PERIOD

*** GANDHIMATHI, S.**

Abstract

Economic growth is strongly associated with monetary aggregates such as the money supply, rate of interest and rate of inflation. The economic theories state the relationship between monetary aggregates and economic growth. The classical theory states that the increase in the money supply will increase the price level in the long run. Keynes view was that increase in the money supply would contribute to economic growth if there is unemployment and under employment. Money and Monetarism Theory suggests that in the long-run, prices are chiefly influenced by the growth rate in money, whilst having no genuine effect on growth. If the growth in the money supply is higher than the economic growth rate, inflation will result. The policy of demonetization in the India economy, in 2016, is expected as an important factor to determine the money supply which in turn set back the economic growth. Keeping in view of the above, this study examines how gross domestic product and money supply in India had grown in the pre and post reform period. The findings of the study showed that, both gross domestic product and money supply had shown an increasing trend in both pre and post reform period. The growth of both gross domestic product and money supply were higher in post reform period than in pre reform period. The compound and exponential growth rates of gross domestic product and money supply registered positive growth in both pre and post reform period.

Introduction

Economic growth is strongly associated with monetary aggregates such as the money supply, rate interest and rate of inflation. The economic theories states the relationship between monetary aggregates and economic growth. The classical theory states that the increase in the money supply will increase the price level in the long run. The keynes view was that increase in the money supply would contribute to economic growth if there is unemployment and under employment. Money and Monetarism Theory suggests that in the long-run, prices are chiefly influenced by the growth rate in money, whilst having no genuine effect on growth. If the growth in the money supply is higher than the economic growth rate, it will result in inflation. But Phillips curve concept put forward that

* Professor, Department of Economics, Avinashilingam Institute for Home Science and Higher Education For Women, Coimbatore – 641 043

higher rate of inflation confidently and positively influences the economic growth by making lower rate of unemployment. In general, rate of interest influences the economic growth and inflation. Higher the rate of interest, lower will be the investment and economic growth. Rates of interest are an important factor in determining the economic environment wherein investment has to take place, particularly while numerous companies are not cash affluent. High rates of interest moreover shock foreign direct investment owing to the exchange rate uncertainty since the market anticipates rates of interest ultimately go down. Again, lower the rate of interest, superior is the money supply in the economy and superior purchasing power of individuals. This will effect in increase in the goods price, because demand will be more than supply of the goods. Influencing rate of interest therefore makes a disparity in economic growth and inflation.

Moreover, the policy of demonetization in the Indian economy, in 2016, is expected as an important factor in determining the money supply which in turn set back the economic growth. Keeping in view of the above, this study examines how gross domestic product and money supply in India had grown in the pre and post reform period. The study objectives were to assess the trend in gross domestic product and money supply in pre and post reform period and estimate the growth of gross domestic product and money supply between pre and post reform period.

Methodology

Data Source and Type

The data on gross domestic product, and money supply were obtained from the Hand book of Indian Economy published by the Reserve Bank of India and Economic survey for the period 1969-70 and 2016-2017. The data used for the current study were purely secondary in nature. As the data were availed for the above stated period, the study period was split into pre and post reform period. The pre reform period was considered as the period between 1969-1970-1990-1991. The post reform period was considered as the period between 1991-1992-2016-2017.

Econometric tools

The statistical and econometric tools used to fulfill the objectives of the study are listed below:

Compound Growth Rate

In order to analyze the trends in the gross domestic product, money supply, rate of inflation and rate of interest, the compound growth rate was employed.

The form of the equation used in the study was,

$Y = AB(x)^t$

Y = the variable under study for compound growth rate

A = constant

x = time period

B = co- efficient of time trend

Compound growth rate = Antilog (B-1)*100

Exponential Growth Rate

In order to estimate the growth in the gross domestic product, money supply, rate of inflation and rate of interest, exponential growth rate was calculated.

The form of the equation used in the study was,

$Y = ab^x$

Y = the variable under study for exponential growth rate

a = constant

x = time period

b = co- efficient of time trend

Results and Discussion

Trends in Gross Domestic Product in India

Gross domestic product in India was expected to show the variation between pre and post reform period. Trends in gross domestic product in India is studied and discussed under the following heads.

- Trends in Gross Domestic Product in India in the pre-reform period
- Trends in Gross Domestic Product in India in the post-reform period

The agriculture sector dominated in the gross domestic product of India in the pre-reform period. The contribution of agricultural sector was more than 50 per cent and the contribution of industrial sector was less than 30 per cent in the gross domestic product of India. The trends in gross domestic product in India in the pre-reform period is shown in Table 1.

Table 1. Trends in Gross Domestic Product in India in the Pre-Reform Period

(Rs. Billion)

Year	GDP at constant prices
1970-1971	5897.86
1971-1972	5957.41
1972-1973	5938.43
1973-1974	6208.72
1974-1975	6280.79
1975-1976	6846.34
1976-1977	6931.91
1977-1978	7449.72
1978-1979	7859.64
1979-1980	7450.83
1980-1981	7985.06
1981-1982	8434.26
1982-1983	8686.91
1983-1984	9362.69
1984-1985	9733.57
1985-1986	10138.66
1986-1987	10576.12
1987-1988	10949.92
1988-1989	12062.43
1989-1990	12802.28
1990-1991	13478.89

Source: Handbook of Indian Economy, Reserve Bank of India 2018

The value of gross domestic product was Rs**.** 5897.86 billion in 1970-1971. It had shown an increasing trend in the pre reform period and reached Rs. 7985.06 billion in 1980-1981, Rs.9733.57 billion and Rs.13478.89 billion at the end of the pre-reform period. It revealed significant increase in the gross domestic product in the pre reform period.

In the post reform period, the industrial policy was framed in such a way to accelerate the growth of industrial sector. The industrial policy reforms in the post reform period increased the share of industrial sector to the gross domestic product. The trends in the gross domestic product in the post-reform period is shown in Table 2.

Table 2. Trends in Gross Domestic Product in India in the Post-Reform Period

(Rs. Billion)

Year	GDP at constant prices
1991-1992	13671.71
1992-1993	14405.03
1993-1994	15223.43
1994-1995	16196.94
1995-1996	17377.4
1997-1998	18763.19
1998-1999	19570.31
1999-2000	20878.27
2000-2001	22549.42
2001-2002	23484.81
2002-2003	24749.42
2003-2004	23484.81
2004-2005	24749.62
2005-2006	25709.35
2006-2007	27757.49
2007-2008	29714.64
2008-2009	32530.73
2009-2010	35643.64
2010-2011	38966.36
2011-2012	41586.76
2012-2013	45160.71
2013-2014	49185.33
2014-2015	52475.3
2015-2016	81066.56
2016-2017	85465.52

Source: Handbook of Indian Economy, Reserve Bank of India 2018

The value of gross domestic product was Rs.13671.71 in the beginning of the reform period. It had increased to Rs.17377.4 in 1995-1996, Rs.20878.27 Crore in 1999 -2000, Rs.25709.35 in 2005-2006 and Rs.85465.52 in 2015-2016. It revealed that the gross domestic product had shown an increasing trend in the post-reform period.

Money Supply

The trend in the money supply was analysed to study the relationship between money supply and gross domestic product. The trend in the money supply was studied under the following heads:

1. Trend in money supply in the pre reform period
2. Trend in money supply in the post reform period

1. Trends in Money Supply in the Pre-Reform Period

The monetary policy in the pre-reform period was described as controlled monetary policy. Therefore, the supply of money was expanded with controlled bank rate, cash reserve ratio and statutory liquidity ratio prescribed by the Reserve Bank of India. In the present study, M1 and M3 were considered as the components of money supply. The trends in M1 and M3 in the pre-reform period are shown in Table 3.

Table 3. Money Supply in the Pre-Reform Period (Rs. Billion)

Year	M1	M3
1970-1971	69.03	103.26
1971-1972	77.4	118.14
1972-1973	87.78	137.46
1973-1974	103.63	164.74
1974-1975	115.78	187.17
1975-1976	125.62	210.52
1976-1977	144.85	252.37
1977-1978	164.96	302.63
1978-1979	155.29	364.34
1979-1980	184.79	437.92
1980-1981	208.91	509.66
1981-1982	239.36	597.93
1982-1983	265.63	685.15
1983-1984	304.76	805.77
1984-1985	360.56	952.95
1985-1986	408.47	1110.96
1986-1987	468.36	1306.53
1987-1988	538.14	1532.07
1988-1989	618.38	1796.87
1989-1990	742.25	2138.56
1990-1991	872.17	2494.93

Source: Handbook of Indian Economy, Reserve Bank of India

Money supply in India consists of M1 and M2. M1 includes currency with the public plus deposit money of the public (demand deposits with the banking system and 'other' deposits with the RBI). M2 includes M1 plus savings deposits with post office savings banks (Monetary Statistics, Reserve Bank of India, 2007). The component of money supply M1 was Rs. 69.03 billion and M3 was Rs.103.26 billion was in 1970-1971. Both M1 and M3 had increased to Rs.125.62 billion and Rs.210.52 billion respectively in the period 1975-1976. The same again had increased to Rs. 208.91 billion and 210.52 billion in 1980-1981. Finally both M1 and M3 had reached to 872.17 billion and 2494.93 billion at the end of the pre-reform period.

2. Trends in Money Supply in India in the Post-Reform Period

In the post-reform period, Reserve Bank of India used indirect method of money supply such as open market operation to increase the money supply. The trends in the components of money supply M1 and M3 in the post-reform period is shown in Table 4.

Table 4. Trends in Money Supply in the Post -Reform Period (Rs. Billion)

Year	M1	M3
1991-1992	1039.7	2924.03
1992-1993	1200.5	3442.38
1993-1994	1363.53	3990.48
1994-1995	1692	4781.96
1995-1996	1982.83	5529.53
1996-1997	2217.64	6426.31
1997-1998	2484.65	7520.28
1999-2000	2796.38	9012.94
2000-2001	3206.3	10560.25
2001-2002	3565.88	12240.87
2002-2003	3976.83	14200.07
2003-2004	4455.13	16479.54
2004-2005	4504.182	15913.25
2005-2006	4812.756	17116.47
2006-2007	5121.331	18319.68
2007-2008	5429.905	19522.89
2008-2009	5738.48	20726.1
2009-2010	6047.054	21929.31
2010-2011	6355.629	23132.52
2011 -2012	6664.203	24335.73
2012 -2013	6972.778	25538.94
2013-2014	7281.352	26742.15
2014-2015	7589.927	27945.36
2015-2016	7898.501	29148.57
2016-2017	8207.076	30351.78

Source: Handbook of Indian Economy, Reserve Bank of India, 2018

The supply of money in terms of M1 and M3 had shown an increasing trend in the post-reform period. The amount of M1 was Rs.1039.7 billion in the year 1991 -1992. It had increased to Rs.1982.83 billion in 1995-1996, Rs.2796.38 billion in 1999 -2000, Rs.4812.756 billion in 2005-2006, and Rs.6047.054 billion in 2009-2010 and finally it reached Rs.8207.076 billion in 2016-2017. The value of M3 was Rs.2924.03 billion in the year 1991-1992, increased to 5529.53 billion in 1995-1996, Rs.10560.25 billion in 1999-2000, Rs.15913.25 billion in 2004-2005, Rs.21929.31billion in 2009-2010 and finally reached Rs.30351.78 billion in the year 2016-2017.

Compound and Exponential Growth Rate of Selected Monetary Aggregates and Gross Domestic Product

Money supply contributes to economic growth. Money supply would contribute to economic growth under the condition of un employment and underemployment in the economy. An attempt was made to assess the growth of selected aggregates such as gross domestic product, money supply, inflation rate and interest rate using the compound and exponential growth rates. The results of compound and exponential growth rates in pre and post reform period are shown in Table 5.

Table 5. Compound and Exponential Growth Rates of Selected Aggregates (Percentage)

Variables	Pre reform period		Post reform period		Overall Period	
	Compound growth rate	Exponential growth rate	Compound growth rate	Exponential growth rate	Compound Growth rate	Exponential growth rate
Gross Domestic Product at Market Prices	4.3	4.3	6.8	6.6	5.5	5.4
Money Supply	17.5	16.1	16.8	15.5	17.1	15.8
Inflation rate 2	2	- 8	- 8	-1.2	-1.2	
Interest rate 2	2	-1.2	-1.2	-1	-1	

Source: Estimation based on the data from the Hand book of statistics on Indian Economy, Reserve Bank of India, 2016 and Economic Survey

The compound and exponential growth rates of gross domestic product in the pre -reform period were 4.3 per cent. In the post -reform period, the compound growth rate was 6.8 per cent and the exponential growth rate was 6.6 per cent. It showed higher growth rate of gross domestic product in the post-reform period. The compound growth rate of money supply was 17.5 per cent and the exponential growth rate was 16.1 per cent in the pre-reform period. The same was 15.5 per cent and per cent in the post reform period. The overall compound and exponential growth rates of money supply were 17.1 percentageand 15.8.

The growth rate of inflation rates registered 2 per cent in the pre-reform period. In the post-reform period, the same registered -8 per cent. It showed negative growth rate of inflation in the post reform period. The growth rate of interest rate was 2 per cent in pre reform period and -1.2 per cent in post -reform period. It showed negative growth rate of interest rate in the post-reform period.

Conclusion

To conclude, both gross domestic product and money supply had shown an increasing trend in both pre and post reform period. The growth of both gross domestic product and money supply were higher in post-reform period than in pre-reform period. The compound and exponential growth rates of gross domestic product and money supply registered positive growth in both pre and post-reform period.

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CHILD SEXUAL ABUSE AND TRAUMA IN DINA MEHTA'S "*GETTING AWAY WITH MURDER*"

ISAI ARASI, T. *
CHRISTINA REBECCA, S. **

Abstract

Dina Mehta is a prominent writer, her plays deal with social issues related to women. She exposes patriarchal interpellation and violence against women in her plays. The play *Getting Away With Murder*, talks about diverse problems like sexual assault, gender discrimination, sexual harassment, insecure relationship and infanticide. This paper attempts to explore scorching and escalating issue of girl child sexual abuse in India. Her plays traces the inner psyche of victims. The sexually abused children suffer from post-traumatic stress disorder which affects them physically and mentally.

Keywords: Girl child, sexual abuse, trauma, fear, hopelessness

Introduction

Play is an art and it is a reflection of human life and society. Indian women playwrights perfectly make use of the art to reach people. They make theatre as a media to expose the brutality of patriarchal interpellation and gender apartheid. Women playwrights brilliantly handle the play to create awareness and revolution among women. They mainly focus on some serious social issues like rape, sexual harassment, child sexual abuse, trafficking, dowry death, etc. Dina Dina Mehta has written two novels: *And Some Take a Lover* and *Mila in Love* and two books of short stories. She won a number of prizes for her plays like *Brides Are Not for Burning*, *The Myth Maker*, *Tiger Tiger*, *Getting Away With Murder* and *A Sister Like You*.

Dina Mehta dramatizes indeed social problems and the subjugation of women in current scenario. She has raised her voice against the patriarchal society and her women characters are very bold and not docile to the society. They live their life on their own. Her play *Getting Away With Murder* is about child sexual abuse. This play is published in a collection of play called *Body Blows: Women, Violence and Survival*. She not only stops with abuse but also deals with psyche of the victim. The play deals with body blows like sexual harassment, infanticide, child sexual abuse, gender discrimination and insecure relationship.

The National Crime Record Bureau has given a data that in India in 2018 nearly

* Ph.D Research Scholar, Department of English, Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore – 641 043.

** Professor, Department of English, Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore – 641 043.

109 children were sexually abused by each and every day. Especially girl children experiencing more abuse than boys. Lock down compounded the problem. During this pandemic The Ministry for Women and Child Development, received 3.07 lakh calls within eleven days. In which most of the calls were about violence and abuse of children. This shows that human beings are losing their humanity. Generally the trustee people abuse children than the strangers. This has shown clearly in the play *Getting Away With Murder*. The protagonist, Sonaliis sexually abused by her own uncle, who she is consider as a guardian. He is in the position to defend her but he plays a crucial game to destroy the life of twelve-year-old girl.

The crimes against girl child is increase every day. Eami Mathew in his article "Male Interpretation of Female Torture," quotes Judith Lowder Newton's opinion that "power is the ability to impose one's self on another or to defend one's self from imposition." (qtd. Mishra10) Sonali's uncle uses his power to abuse her than to protect her. Instead of defending her, he exploits her. Children become the victims soon because they are in powerless position compare to adults and they are not aware what is happening around them. The perpetrators use this as an opportunity to pursue their brutal activity to exploit the children. Sometimes the abuser may threaten the victims to be silence. Sonali's uncle comes to her bed, night after night and "threatened her into silence…and submission … the screams she swallowed must still be tearing her up inside" (BB 88).

Most of the cases are unreported because child sexual abuse is considered or still remain a taboo in India. The society never blames the perpetrator, instead they accuse victims' behavior or slander her character. Family member try to bury the issue than exposing because they give more preference to pride of their family than the trauma victim undergo. In the article, "Crime against children: Realizing gaps in criminology and legislation" declares that:

There is a conspiracy of silence around the subject and a very large percentage of people feel that this is a largely western problem and that child sexual abuse does not happen in India. Part of the reason of course lies in a traditional conservative family and community structure that does not talk about sex and sexuality at all. Parents do not speak to children about sexuality as well as physical and emotional changes that take place during their growing years. As a result of this, all forms of sexual abuse that a child faces do not get reported to anyone. This silence encourages the abuser so that he is emboldened to continue the abuse and to press his advantage to subject the child to more severe forms of sexual abuse. (218)

Sonali tries to talk about the abuse with her mother but she gets ignored. Her mother has fails to listen and support her. She undergoes mental and physical agony but, she has no other go but to burry the traumatic experience within her. As a result of which she is not ready to trust anyone because her own mother fails to hear her out. When the affected children try to convey something,

family members should pay attention to them and investigate the issue. Instead they should not overlook them like Sonali's mother. The lack of open discussion and ignorance forces the children to be silent and lonely.

The sexually abused child is neither physically nor mentally mature to face such trauma. Child has deep emotional crisis when the crime is committed by her close relation like father, brother or uncle, who are supposed to protect her. The victims become prey for lusty brutes. When the victims try to speak up the family members never believe them. When they try to open the issue, parents should never believe them. If so, they feel twice betrayed. The sexually abused girls find it difficult to forgive the abuser or forget the trauma of their sexual abuse. Sonali's mother "used to exhaust herself over her household tasks-may be because she was grateful to uncle for taking us in after father died" (BB 59). She respects Sonali's uncle because he is the person who takes care of the family so she fails to trust her own daughter.

The victims of child sexual abuse go through mental and physical pain. The sexual trauma leads to Post traumatic stress disorder. "They are also prone to a variety of psychological and behavioral disturbances caused by trauma of abuse. These could include bed wetting, nightmare, sleep disorders, depression, anxiety, running away from home, multiple personality disorders, precocious sexual behaviour or its reverse, extreme inhibition and low self-esteem caused by a sense of guilt and shame" (FVI, 166-167). Few may overcome the trauma in short period but for some it takes long term. Sonali undergone the trauma and pain throughout her life.

Sonali fails to get rid of the trauma. She is haunted by the past. She always feels nervous and imagines someone is stalking her secretly. These things make her restless and shakes her mental stability. Likewise, the victims of PTSD isolate or disconnect themselves from the present world. Their thoughts are occupied with past trauma. Sonaliis preoccupied by the past, she recalls "Every time I took a bath I could hear him outside … breathing … waiting to look at me without my clothes on … (screaming) get away from my door … get away or I'll tell Anil you're hounding me …" (BB 66). The childhood experience cherishes and shapes one's life. But the victims of sexual abuse carry the burden with them and it totally disturbs their daily life. The scars of sexual abuse in childhood can last for a long time.

Sexual trauma makes victims to distrust the society and they find it difficult to maintain the relationship or emotional bond. Loss of trust sets them apart from the real world and from the society. The shame gradually eats them. The shame has a direct impact on their relationships. Sonali never shares her childhood experience with her family or friends. Whenever she remembers that event, she gets severe headache. She feels nervous and unstable. Sonali feels life is complicated and hopeless.

The abused girls are reluctant to share the sexual assault because they feel ashamed of the event. Sometimes they blame themselves

for allowing the crime to happen. Sonali feels guilty for her uncle death. She denies to talk about the terrible incident with her friends and family. The victims are not stable to take decision they fail to distinguish the right and wrong. Sonali is afraid to give birth to girl child because she does not want her child to suffer in this cruel world. She does not want her unborn child to face the catastrophe that she has undergone. She forces her friend to do amniocentesis which is illegal. She is firm in testing the foetus. Her friend Malu, is shocked and questions thus:

MALU: what is? Female foeticide? My God, this is like something out of a black comedy. Mothers award the death sentences to their unborn daughters in the name of liberation. They thereby prove their woman-power! Their omnipotence! They play God!

SONALI: Shut up, shut up! (Thumping the table) To be born a girl is to be subject t o violence and servitude! I know, I know! (BB 63)

Sonali is not ready to listen to any one, she thinks only the death can bring liberty to the child. The trauma makes her to think the wrong in a right way. She never wants her girl child to be suffered at the hands of someone.

One another symptoms of her trauma is personality disorder. Sonali stands in front of the mirror and talks into it. She considered her as a small girl and modulates her voice and shouts

Dear god, I can't take more of this (tries to light her cigarette, but hand shakes too much). Someone must help … help me (moves to the mirror, stares into her face intently then begins to speak in a petulant 8-year-old voice as she regresses in time). Don't want to sit near him, Mother. Don't like to be touched. Don't like to be tickled … (looks away from the mirror and declaims in her normal voice). Your fingers are not kind, they hurt … don't … (squirming, laughing helplessly) ha ha. Stop it, stop! (Low, on a note of pain and fear.) What are you doing to me, leave me alone (Hands to her mouth, she gags and retches, then turning away from the mirror, in her adult voice.) (BB 66)

The victims may overcome the post-traumatic stress disorder when they undergo proper treatment and counselling. Most important thing is they should have hope in life. They should not feel shame because it is not their fault to be prey for lustful animals. Victims' parents or friends should support them to face the world and to get over the guilt and trauma. The chance should be given to children to speak out the sexual abuse with a person they trust. The real love and support of one may bring positive changes in the life of victims as in Sonali's life.

Anil, Sonali's husband appears like an angel and extends his helping hand to begin a new life with her. He wants to know the truth and abuse faced by his wife during her childhood. His wife may not share her sufferings with him but he can understand her mental turmoil:

ANIL: whatever it is that gives her these feelings of guilt and anger … abusing herself, destructive behaviour … confusion over whom to trust. I think I have a right to know.

ANIL: If you had watched her struggle to remember … a battle fought behind her eyes … bathing her face in sweat, dragging at the corners of her mouth, those frightful headaches … (BB 87)

He gets the information from his brother in law, Gopal. He supports his wife and gives hope to Sonali. She feels free and ready to give birth to her child. She never wants to abort the child. The love and support of her husband and friends help her to gradually come out of the trauma. She starts to trust the people around her and set off a new life.

The government is taking steps to reduce the violence against girl child. India has implemented the Protection of Children from Sexual Offences (POCSO) Act in 2012 to protect children from sexual assault, sexual harassment and pornography. Laws can control the crime but cannot root it out completely. The thought of patriarchal society should be changed. Family should teach boys to respect girls. The view of girl as an object of sexual gratification should be eradicated. Revolution of each and every individual may create a mass change in the society. Victims should speak out the crimes and get the criminals to be punished. This would control or stop the criminals to continue their ruthless act.

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UNDERSTANDING ADOLESCENT BEHAVIOUR - CHANGING TRENDS IN CHALLENGES AND ADJUSTMENTS MADE

GEETHA, T.

Abstract

Adolescence refers to metamorphism from childhood to adulthood. During adolescent's developmental transit multiple in-built biological and chemical changes occur that are reflected in their physiological and neuronal behaviour levels. Accompanied with these internal changes, exertion by external factors such as environmental and social factors of peer pressure during their high school and college days, further influence the adolescent's behaviour to shift towards more of relative independence to that of emotional dependence. Hence, this increase in autonomy during adolescence necessitates studying the challenges faced and adaptations made at personal and public levels in physical, social, emotional and intellectual fronts of vulnerability. The current study was conducted at a local girls high school (n = 20), Coimbatore to identify the types of challenges experienced by the female adolescents and their behavioral adaptations to cope up with the same for their well being.

Introduction

Adolescents are individuals in the age group between 10 to 19 years (https://www.who.int/southeastasia/health-topics/adolescent-health). According to the UNICEF data, they constitute about 1.2 billion that is about 16 per cent of the total global population. (https://data.unicef.org/topic/adolescents/overview/). The largest among them is the Indian adolescents with about 253 million teenagers (https://www.unicef.org/india/what-we-do/adolescent-development-participation). Despite their protection through Rights of the Child Act (2009) up-to 18 years of age, their vulnerabilities often remains unaddressed. Additionally even the UNICEF is monitoring the progress of adolescence well-being through adolescent-specific indicators. However, most of these adolescent services being rendered are unreached by the adolescents due to their socio-demographic challenges for life and work. Hence, it is being insisted by UNICEF that a critical, healthy and productive transformation to adulthood from childhood is required with safe investment to achieve the nations' sustainable target goals.

Adolescence is often characterized by unique multiple, physical, psychological and social changes and demands overtime and across the years. The adolescence age

* Dean, School of Education, Professor, Department of Special Education, Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore – 641043.

demarcation varies widely in reports and hence chronological age differentiation is different across early, middle and late adolescence stages. Their development phase in general is between 10 – 19 years in tune with world health organization adolescence definition. Research studies have proven that a number of risk factors or social influences change their behavioral pattern due to addictions (Marino *et al*., 2020) social media usage (Vannucci *et al*., 2020) usage. An important determinant that possibly could influence adolescence is they strive for autonomy and independence with increased risk taking pro-social behaviour. They spend more time with peers in contrast to less time with parents or the primary care givers (Lam et al., 2014). In addition to these caveats, challenges faced as female adolescents in lower socio economic levels are innumerable and different from their male counterparts. Due to gender differences, female adolescents are the most deprived individuals with restricted access to opportunities to voice and independence other than nature and nurture differences that occur in families and their communities. Considering adolescence as a developmental stage steering between childhood and adult hood the present investigation was intended to study the numerous challenges encountered by them during this transitional life span. Thus the studies objectives were to determine family profile, identify their challenges with their corresponding adaptations and assessing their behavioral pattern during the adolescence transition.

Methodology

The study was conducted during the year 2012 among adolescence girl volunteers from local girl's high school who consented to participate in the study. Adolescent school girls (n = 20) pursuing higher secondary education (Standard 12) at local school were randomly selected for the study after obtaining permission from the school management. The demographics viz., age, family background details were collected from the study respondents in addition to challenges faced and adaptations made by them to confront their daily routine life were gathered using an Interview Schedule developed by the investigator. The data about their physical, personal, family, social emotional and peer relationships were also collected. Information on career expectation, values idolized and future vision was also elicited from the sample. From the qualitative study data variables, significance of the study could not be assessed among as most of study respondents neglected the questions as they were ignorant and hence, only percentage of respondents was calculated across different types of study challenges faced by the adolescent girls with explorative analysis of their adaptation to the corresponding challenges.

Results and Discussion

Demographics

The study population were late stage adolescents with about 60 per cent distribution

in 19 years of age while the remaining, 40 per cent them were 18 years of age. Their nativity was spread across southern region from Coimbatore to Dindugal district. About 40 per cent the study populations were from Coimbatore or Dindigul District. About 20 per cent of these study respondents were from Pollachi town, 40 km down south of Coimbatore District. Hence, in total about 60 per cent of the study respondents were immigrants who moved to the urban location along with their parents to pursue their Higher Secondary Education. Preferably about 80 per cent of the girl respondents pursued education only in their local native regional language Tamil. Their household constituted a maximum of 4 to 5 members in greater than 80 per cent of the population. Girl respondents had lower pro-social activities contribution to about only 20 per cent as indicated by their involvement in national social service scheme. This indicates they strived for more of social networking with their peers rather than with the community that was indicated through their more involvement in sports activities (80%) by being sports enthusiastic. In agreement with the above, Lei *et al*. (2020), correlated increased sports behaviour with social networks that reflects their social efficacy and self-presentation on the contrary this also showed the elevation of individualism over communalism (Lichter *et al*., 2002) among the girls study respondents. Their parents were mostly skilled workers who were involved in agriculture activities (60 per cent) or were working as are for their children's future career.

Behavioral Adaptations to Adolescent girls Challenges as an Individual in the Family

Adolescents due to their physical and glandular changes in their transition phase of life cycle experience psychological outbursts, emotional tension and instability commonly stated as "Stress and Storm" during this period. Among the emotions responded by the study participants represented in Table1, stress seemed to be one of the highest emotional challenge (80 per cent) encountered by them followed by depression and anxiety to about 60 per cent where as only 40 per cent of the study subjects reported about fear. They also were aware of the reasons behind their emotional challenges and the skill they must work on to handle them appropriately in future. Almost 60 per cent of the adolescents experienced anxiety and depression as a resultant feeling of dissatisfaction, loneliness and lower academic achievement. Such unexpected and unwanted set backs were overcome by better adjustment, spending time with friends and effective participation in all activities both at home and in school. Unattained goals and non-accomplishment of tasks led to anger and in turn led to evolving effective strategies to overcome the same by recognizing the hurdles.

Table 1. Behavioral Adaptations to Adolescent Girls Emotional Challenges

Emotional Challenges	Sample Responding (%)	Adaptations made
Stress	80	Involvement in normal regular routine, Effective goal setting
Depression	60	Better adjustment, Spend time with family and friends Note making
Anxiety	60	Effective and higher goal setting, Setting deadlines
Fear	40	Engage in useful tasks, Relaxation.
Sad	40	Happy and joyful relationships, Good and strong peer relationships

Young adolescents residing away from home in the hostels had stated a longing to be with their parents during the holidays and sharing of household responsibilities when at home. In the current study being in the company of peers had proved to be a very joyful and happy experience alternatively. The challenge was in utilizing the best of opportunities to spend their time preferably at home and in school.

Behavioral Adaptations to Challenges in Social Environment

Various social environments influence the adolescent's behaviour. Some of the study selected adolescent challenges in different social environments of house, school and peer environment are represented in Table 2. It was understood from the Table that, 80 percent of adolescents who responded considered performance of personal tasks a challenge and therefore managed their time in order to meet time deadlines to school, tuitions, etc both within the home and outside. Sharing of responsibilities in completion of tasks and upgrading their skill in the performance of tasks also made possible in overcoming the challenges. The challenge of putting in extra time and effort in attending to tuitions was channelized by waking up early in the morning, sharing responsibilities with siblings and working late hours. Most of the adolescents were involved in completion of household chores – a shared responsibility especially in situations when both parents are working though found to be a challenge on certain occasions could be overcome by sharing the tasks especially cooking and cleaning the house. Only 40 per cent of either parent were involved in offering support and guidance to the adolescents in the form of motivation and encouragement. The same were the expressions with reference to other family members who included grandparents, siblings and at times other elders in the family viz uncles and aunts. Only 20 per cent teachers were seen to render support as words of encouragement and guidance in the completion of day to day academic tasks.

Adolescents as a student in school face challenges with teachers as part of education and work accomplishments. Around 80 percent of the adolescents were of the view that the teachers had very high expectations and always set very high targets for improvement in performance. Considering the same as a challenge to accomplish enabled the sample

to plan for effective study habits and set higher targets for achievement. Working towards a goal and on time task completion were considered a challenge by 60 per cent of the adolescents effectively accomplished by them through effective implementation and a thorough organization of work schedule. The sample expressed their need for appreciation by the teachers and taking it up as a challenge were capable of bringing out the best in them both academically and otherwise.

During adolescence social changes elevate in many respects such as increased influence of peer group, changes in social behaviour, new social groups, new values in friendship, social acceptance and rejection. Considering the challenge faced by the adolescents in peer relationship, it was observed that 60 per cent of them had considered maintaining relationship or cooperation with peers as rather difficult while 40 per cent of them expressed their inability to achieve their goals and poor task completion. The varied challenging situations necessitated the adolescents to pave way for appropriate adaptations such as involvement in groups, developing coping skills, developing strategies to cope with all changes and avoid laziness in order to achieve and be accepted in their groups.

Table 2. Adolescent Girls Challenges Encountered in Different Social Evironments and their Behavioral Adaptations

Challenges / study variable in different Social setting	Sample Responding (%)	Adaptations made
House Environment		
Household tasks	40	Cleaning the house, Assist in cooking, Accept any task assigned.
Personal tasks	80	Managing time, Sharing resources, Skill training
Extra tuitions	40	Waking up early, Sharing responsibilities with Siblings working late hours
School Environment		
Expectations	80	Well planned work schedule
Performance	80	Aim to achieve higher
Work towards goal	60	Effective implementation of plans made
Peers environment		
Task completion	60	Organization of work
Cooperation	60	Involvement in group activities
Expecting cooperation from peers	40	Having good coping skills
Inability to achieve goals	40	Evolve effective strategies in planning and working
Task completion	40	Avoid laziness

Behaviour Adaptations to Adolescent's Challenges for Future Well being and Betterment

Performing well at examinations and completion of assignments on time are some of the challenges adolescents confront with little guidance and support both from the parents and teachers they are capable of bringing about changes in their schedule of activities and in the actual performance ultimately reaping the benefits of both. Their good performance in examinations and assignments were indicated with 80 per cent accomplishments. It was noted that 60 per cent of the sample did experience difficulty in scheduling time and performance in the examinations (40%) a constrain, submission of assignment were not easy, and this necessitated effectively planning to perform better by referring books accessing the net thereby aiming to achieve the best possible output.

Some of the extracurricular activities in which adolescents participated necessitated them to consider the same as a challenge in enhancing their performance. Depicts the role and consider of the sample in the extra-curricular activities offered in school during the final year of schooling. Though not all the sample were involved in extracurricular activities, only 60 per cent considered regular practice a pathway to achievement of success in performance related to non – academic activities. Participation and performing well in NSS activities was also aimed at by only 40 per cent of the sample. It was surprising to note the almost 80 per cent were involved in Sports and did perform well gaining experience and exposure with skill training and reaching the goal necessitated them to set the challenge to using the games with justice and objectives.

What will I do on leaving school is often an unanswered question during this stage. These questions became critical during adolescence for choice of an occupation and a career. Work opportunities can provide adolescents, with a sense of purpose and responsibility, allowing then to participate in society in a realistic way and help them to practice communicating with adults to maintain relationships. Adolescents do recognize the independence that come with a job, but they have only a vague idea of their competency and skill in performing at a job. Which they could enjoy meeting both to present and future demands and the training required. This aspect of the tool data revealed that all the subjects intended to use the best of opportunities as a challenge for deciding the choice of a vocational. Similarly 60 per cent still preferred teaching in a school, while another 40 per cent had gave for an alternative choice of teaching at home.

Table 3. Challenges and Adaptations made by Adolescents for their Progressiveness and Well-being

Challenges	Sample stating (%)	Adaptations
Curricular Challenges		
Examinations		
• Use time effectively	80	• Scheduling time
• Lazy to perform	60	• Scheduling activities
• Poor recall	40	• Repetition and exercise
• Improve performance	40	• Start early
Assignments		
• Difficult task	80	• Plan to perform well
• Writing the assignment	80	• Schedule the task
• Referring Books	80	• Library and source
• An aim to perform well	60	• Aim high and perform well
Extra Curricular Challenges		
• Participation	60	• Practice regularly
• Performance	60	• Plan ahead
• Prior Preparation	40	• Participate with skill
• Eager to take up NSS	40	• Regular programmes
Sports		
• Regular Practice	80	• Plan to work
• Acceptance of defeat	20	• Play and win, Practice and Training
Vocational Challenges		
• Use the best of opportunities	100	• Availing the available opportunities
• Teaching in school	60	• Working hard
• Teaching at home	60	• Time Management

Conclusion

Childhood is a phase of challenges particularly during early adolescents. This period is considered as the transitional period in the life span of a human being. It is indeed a problem –solving stage, a time of unrealism as the threshold of adulthood. Therefore, proper education, guidance and counseling would help in avoiding social discrepancy and remedy unwanted behaviour, help to identify their interests and make them contributing members of the society.

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RESEARCH ABSTRACT

ANTIMICROBIAL ACTIVITY OF CHITOSAN NANOPARTICLES AGAINST SELECTED MICROBIAL STRAINS

*** SANTHANAMBIKA, M.S.**
**** MAHESWARI, G.**

Abstract

Polysaccharides are natural biopolymers with immense bioactive potential. An eco-friendly recycling approach to derive nano-formulation of amino-polysaccharides, chitosan, de-acetylated form of chitin obtained from the bio-waste / shell waste of crustacean, prawns (*Penaeus indicus*) were studied and reported for its varied antimicrobial activity. Chitosan, with its net cationicity due to the presence of multiple reactive functional groups exhibited more antimicrobial activity against the selected microbes. Thus, nano-chitosan renewed from prawn waste can be suggested as an effective antimicrobial agent with versatile applications as bio therapeutic compounds.

Keywords: *Chitin, Chitosan, antibacterial, antifungal, Prawn, Shell*

Introduction

The shell waste accumulation from fish-food processing units contributes to environmental pollution due to improper discard of large biomass waste near coastal areas. It generates unpleasant noxious odor that attracts pathogenic organisms and can adversely cause environmental impact without proper discharge. The seafood industry generates globally about 106 tons of waste (Sivaraman*et al*., 2019) that are ordained to be composted or converted in to low value added byproducts. Thus, waste management strategy with recycling and retransformation in to a high value added products could benefit both the environment and the sustainability of the small scale fish food processing units.

Approximately about 2000 tons of chitosan is produced annually, whose main source of extraction is from shrimp and crab shell residues (Schmitz *et al*.,2018). Few reports claim for the bio-mass valorization of prawn shells waste into biopolymers. The recent progress in the synthesis of biopolymers from bio-waste coupled with nanotechnology increased the quest to formulate nano-biopolymers to foresee its

* Ph.D., Research Scholar, Department of Zoology, Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore – 641 043

** Assistant Professor (SS), Department of Zoology, Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore – 641 043

enhanced therapeutic effect. Therefore, an attempt has been made in the current study to develop nano-formulated antimicrobial high value by-products from crustacean (*Penaeus indicus)* outer-shell discards of the fish food processing unit.

Methodology

The prawn shell waste of *Penaeus indicus* commonly known as Indian prawn was collected from local fish market at Ukkadam, Coimbatore. The prawn shell wastes were subjected to different processes such as pre-wash with water, deproteination, demineralization, decolourization and deacetylation process to get raw chitin and chitosan.The raw chitin was subjected to degree of deacetylation for 45 hr. to get a yield of about 18% of the chitosan. The polycationic chitosan extracted from prawn shell, assembled poly anionic sodium tripolyphosphate by ionic gelation method to form nano-composites of chitosan (Yien *et al.* 2012).

Ten gram of chitosan was dissolved in 100 ml of 0.5 N Hydrochloric acid (HCl). The pH was then adjusted to neutral (7) by the addition of 0.5 N sodium hydroxide and the solution was diluted with distilled water to make the stock solution of 1000 ml (1L). From this, the working solution was taken for the antimicrobial study of the chitosan nano particles (Sakif *et al.* 2016).

The antimicrobial activity of the nano-composite of chitosan derivative from prawn shell was evaluated by agar well diffusion method (Alqahtani *et al.* 2019). The agar plate was prepared. After solidification of agar, the plates were individually inoculated with *Bacillus sp., Staphylococcus aureus, Escherichia coli, Salmonella sp.* and *Pseudomonas aeruginosa* (12 µl).The well were made on the solidified inoculated agar, after which antimicrobial nanocomposite of chitosan (5 µl working solution) were poured. The plates were incubated at 35°C for 24 hours and they were examined for clear zone of inhibition across the wells.

The efficacy of the chitosan nanoparticle against the selected fungus were evaluated with Rose Bengal Chloramphenicol media (King *et al.,* 1979). After solidification, the plates were inoculated with (10 µl) selected test strains *Aspergillus niger, Aspergillus flavus, Penicillium sp., Rhizopus sp.* and *Candida sp.*The working solution (5 µl) of chitosan were poured into the well. The plates were kept at room temperature for 24 hours and examined for the zone of inhibition.

Results and Discussion

Chitosan nanoparticles exhibited a wide range of bioactivity as an antibacterial bio-compound against the tested bacterial isolates. The diameters of inhibition zone against *Bacillus sp., Staphylococcus aureus, Escherichia coli, Salmonella sp.* and *Pseudomonas aeruginosa* were 17, 12, 15, 14 and 16 (mm) respectively. The amphicillin (positive control) showed the zone of inhibition as 23 mm in diameter. Chitosan nanoparticles showed antibacterial activities against food-borne bacterial isolates including *Bacillus sp., S. aureus, E. coli, Salmonella sp.,*

and *P. aeruginosa*. These results are in agreement with Dutta *et al.* (2009) and Wang *et al.* (2013) who investigated and confirmed the antibacterial properties of chitosan. They also found that chitosan has been shown to inhibit both Gram-positive and Gram-negative bacteria, including *Staphylococcus aureus*, *Bacillus sp.*, *Escherichia coli*, *Pseudomonas aeruginosa* and *Salmonella sp.*

Chitosan nanoparticles also showed strong antifungal activity against all tested strains of fungal populations. The diameters of inhibition zone against *Aspergillus niger*, *Aspergillus flavus*, *Penicillium sp.*, *Rhizopus sp.* and *Candida sp.* were 18, 13, 14, 17 and 11 (mm) respectively and the fluconazole (positive control) showed 25 mm of inhibition zone. From the findings, chitosan was demonstrated to have higher antifungal activity against fungal strains *A. niger*, *A. flavus*, *Penicillium sp.*, *Rhizopus sp.* and *Candida sp*. The results were in accordance with the findings of Badawy and Rabea, 2009 who demonstrated 1% chitosan and chitosan derivatives to have antifungal activity against *Botrytis cinerea.* The antifungal activity of chitosan is mainly attributed to its capacity to change the permeability of the plasma membrane.

Summary and Conclusion

The dumping of shell wastes from the sea food processing industries could be eliminated, by wasteutilization through recycling and retransformation strategy for the betterment of human society and also to protect our Earth. With this aim, the wastes generated from the fish food market during the prawn cleaning were converted into nano-based antimicrobial bio-polymers. It was also observed that the chitosan nanoparticles with its greater surface possessed higher more antimicrobial activity. Further, exploration of nano-based biopolymer toxicity could help us to recommend its versatile application as effective antimicrobial agent.

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NEWS MAKER

COVID-19 VACCINE IN PROGRESS ACROSS THE WORLD

*** SHANMUGA PRIYA, M.**

The whole world suffers from the COVID 19 pandemic and all people have left their homes after the pandemic and follow new safety protocols and safety measures to ensure their health and immunity. The World Health Organization works effectively to monitor those affected people and distribute appropriate medical supplies, and now it is rushing to all countries and researchers to develop effective vaccines. WHO is working collaboratively with scientists, businesses and global health organizations through the right channel to accelerate the response to the pandemic situation.

World's first approved vaccine in trial

By the end of 2020, many countries and researchers are proposing vaccine trials and therefore the UK becomes the primary country to approve a vaccine for coronavirus that has already killed 1,487,701 people worldwide. There are currently more than 50 candidate vaccines in trials around the world. Following the approval of the UK's Pfizer / BioNTech vaccine candidate, many countries have offered to self-vaccinate their population.

In addition to Pfizer / BioNTech, the Moderna vaccine candidate is claimed to be 94.5% effective in preventing Covid and is probably going to be approved for emergency deployment among us. From India, Oxford-Astrazeneca, Johnson & Johnson and Sputnik V from Russia showed promising results at different stages of the study.'

Russia coronavirus update

President Putin ordered the Russian authorities to start voluntary mass vaccinations against COVID-19. Russia will have produced 2 million doses of the vaccine, and the Sputnik V was 92% effective in protecting people from the corona virus according to interim results.

Sputnik V- Clinical studies in India

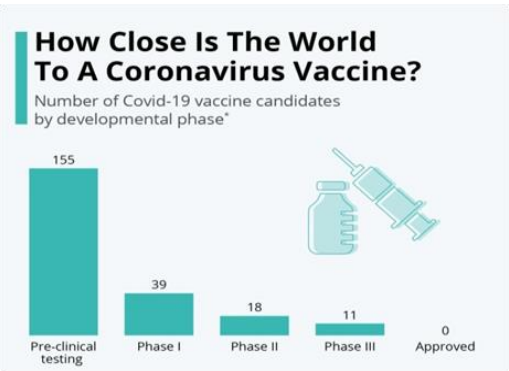
The laboratories of Dr. Reddy and the Russian Direct Investment Fund (RDIF) have initiated adaptive phase 2/3 clinical trials for the Sputnik V COVID-19 vaccine

* Ph. D Research Scholar, Department of Chemistry, Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore - 641 043.

in India. The trials began after receiving the required authorization from the Central Drug Laboratory.

Vaccine update in Mexico

The government of Mexico is prepared to sign a contract with drug company Pfizer for the delivery of its coronavirus vaccine. Pfizer has submitted details of its vaccine to the Mexican health authority, and the Mexican government expects the vaccine to arrive in December.



Pfizer / BioNTech vaccine

Phase 3 trials of the Pfizer / BioNTech vaccine involved 42,000 people, about half of whom received the investigational vaccine. In total, 170 people who fell ill with COVID-19, only eight of them were in the vaccine group; the other 162 were from placebo group. That is only about 5% of cases were affected in the vaccine group. This is a very healthy and satisfactory figure according to the World Health Organization (WHO).

The active ingredient is messenger RNA that carries the instructions to make the virus spike protein, which it uses to enter cells. The mRNA is synthetic, not extracted from real viruses. It comes in a small ball of inert fatty material called a lipid nanoparticle.

The RNA-containing nanoparticles are suspended in a saline solution and injected into the muscle tissue of the upper arm. The mRNA is then absorbed by specialized immune cells, which follow its instructions to make the spike protein, just as they would if they were infected with the real virus.

The spike protein is recognized as foreign by the immune system, which attacks it. Antibodies, B cells and T cells are activated, according to UgurŞahin, CEO of the small German company BioNTech who co-developed the vaccine with US pharmaceutical giant Pfizer.

The trial began assessing immunity seven days after the second shot. It is active for a few days and then disintegrates quickly. Protective immunity builds up within four weeks of the primary dose, but Sahin says it appears to develop sooner.

Source:

1. https:// www.who.int/emergencies/diseases/novel-coronavirus-2019/covid-19-vaccines
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SHORT COMMUNICATION

GOLD : AN EVER SHINING INVESTMENT

*** SANTHI, P.**

Monetary counsellors' state gold should certainly bear a significant proportion of any investor's wealth accumulation approach. Gold is a hardy perennial. It offers a mental and material place of refuge for individuals all around the globe and its invocation still creates profound situated instinctive responses in many.It is a valuable yellow, splendid and exceptionally esteemed metal that has been known, acknowledged and utilised for a great many years. The earliest archived goldmine on the planet, assessed to be 4,000 years of age was found in Tbilisi (Georgia) in 2005. The inceptions of gold are viewed as "cosmic".In 2013, the Harvard-Smithsonian Centre for Astrophysics noted that observations have found evidence that gold was created in a short gamma-ray burst resulting from "the collision of two neutron stars − the dead cores of stars that formerly detonated as supernovae". Gold is among the rarest elements in the earth's crust, where it is mainly present in its native form (about 80 per cent of the total metal worldwide); it can likewise be related with different components, for instance, silver- resulting basically in the components electrum and tellurium-yet additionally with copper or iron, among others.

Gold is an extremely pliable and malleable metal that can be structured and bent effortlessly. It is considered a heavy metal and one of the densest elements in the periodic table. It is a noble metal, which means that it presents an exceptional resistance to oxidation. However, goldcan be dissolved in aqua regia. Gold is also a good conductor of heat and electricity, and a strong reflectorof infrared radiation. Based on these characteristics, it is used as input in many industries, such as jewellery, dentistry or electronics, and for electrical applications. However, its softness and high price stend to limit its use to sectors where no efficient substitutes have been developed, or encourage its mixture with other metals. Gold is also used for monetary purposes (e.g. coinage), as a safety resource and investment medium in the course of economic variability.

There are numerous reasons, which drive people towards purchasing or investing in gold. Basically, the liquidity of gold investment is higher than the physical assets like real estate. Further, in contrast to several other assets, there is no lock-in period in gold ventures besides sovereign gold bonds. However, in case of physical gold, the redemption amount will depend on the purity of the gold, denomination and other factors

* Professor, Department of Commerce, Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore - 641 043.

including the market price. Gold loans are secured loans to which gold jewellery is utilised as collateral security. The loan amount is usually a percentage of the gold's value. After repayment, the borrowers get their gold jewellery back. Nationalized banks, private banks, and other financial institutions provide these loans at reasonable interest rates. This is particularly useful for those borrowers who have to meet a sudden financial goal, such as a marriage or a child's education and instead of selling gold, they prefer to opt for a loan. Traditionally, having a good collection of jewellery symbolizes power, good status and immense wealth of the owner.

From an investment perspective, gold offers true diversification as it shows no significant correlation with mainstream asset classes. In fact, evidence suggests that when share values fall rapidly, an inverse correlation can develop between gold and equities. Gold protects an investor's portfolio from volatility, because factors that affect the returns of most asset classes, both at the macro-economic and micro-economic levels, do not significantly influence the price of gold. For a given level of returns from a portfolio, adding gold to it may be reduce the risk or volatility.

In Indian culture, gold is the symbol of the Hindu Goddess Lakshmi and considered highly auspicious. Many of these gold coins and bars are bought on the occasion of Akshaya Tritiya and Dhanteras, when buying gold is believed to bring luck to the buyers. Festivals such as Pongal, Onam and Ugadi in the south; the Durga Puja in the east; GudiPavda in the west; Baisakhi and KarvaChauth in the north are also celebrated with gold purchases.Women of every age and time have always loved wearing gold ornaments. Moreover, gold ornaments never go out of fashion. Most people gift gold ornaments to their children during marriage and other important events in life. In this way, gold can be passed down from one generation to the other as ancestral property.

Gold was utilized as a type of currency as prior as 550 BC when King Croesus stamped coins in what is presently Turkey. However, the adoption of the gold standard in the last part of the 1800s, solidified its value in recent day finance. This was when most significant countries estimated a fixed value for their currency to the cost of gold. The gold standard system set up during the period 1870−1914, utilized gold as the world's common unit of account.This implied that the estimation of each participating currency was decided based on the particular weight in gold. Each and every currency could be directly turned into gold, and the nominal conversion standard between two monetary forms was determined by the respective gold content. In this framework, the highest amount of cash that could be given by central banks was decided by its degree of domestic gold reserves.

The gold standards had already been in place in the United Kingdom since 1821, but the system was extended to cover other countries during the 1870s. The gold standard system reached a conclusion with the start of the First World War. After a period of free

floating exchange rates from the end of the First World War to the beginning of the Great Depression, a few countries joined forces to attempt to resuscitate a framework like that of the gold standard. However, the difficult political situation, notably in Europe, fears regarding high inflation risks and the beginning of the Great Depression, followed by the Second World War, led to the definitive collapse of the gold standard system.

Named after the New Hampshire town where the Bretton Woods Agreement was signed, the Bretton Woods system **(1944−1971)** aimed at establishing an adjustable peg currency regime. Each of the participating countries was required to fix its exchange rate by tying it to the United States dollar, which itself was pegged to gold at a fixed value of $35 per troy ounce. The United States currency was chosen as a referenceas that country held three fourths of the world's goldstocks at that time.The system was more flexible than the former gold standard system as the Bretton Woods Agreement allowed a fluctuation of the parity of currencies within a range of more or less 1 per cent around the peg.This flexibility was expected to allow the correction of fundamental disequilibria. Outside this range, stakeholders were required to intervene by buying or selling their currency.

From the beginning of the 1960s, the US dollar started to be seen as overvalued compared with the value defined in the Bretton Woods Agreement. As a result of the rapid expansion of international trade and military spending, the volume of US dollars in circulation increased dramatically and finally exceeded the value of gold effectively held by the United States. The Bretton Woods system collapsed in 1971, following the decision of the United States President, Richard Nixon, to suspend the convertibility of the US dollar into gold. Since 1973, most countries have turned to a free-floating exchange rate system, or to the adoption of another country's currency or to the creation of a single currency in a monetary union, as in Europe.

Gold as an Investment

Gold has always been a coveted asset in India. Along with the financial value of gold, it also has a unique emotional and social value, which pertains to owning physical gold in the form of jewellery, coins or bars. In contrast to mainstream investments like bonds and equity, physical gold carries no credit risks since it is not a liability of anyone, and therefore the uncertainty of a counterparty´s ability to meet its obligations are nonexistent. However, for investment purposes one can invest in gold in different ways listed below

Physical gold

One can invest in physical gold by purchasing gold coins or gold bars from jewellers, banks or online stores (issued by MMTC), NBFCs etc. Gold coins are generally of standard values like 5 and 10 gm, while bars are of 20 gm. These have a purity of 24 karat and convey a hallmark of purity in consistence with BIS norms. This is a conventional way towards gold investment.

Sovereign Gold Bonds (SGB)

Indian government issues SGBs at various point of time. Whenever the issue is made, investors can subscribe to SGBs. Investors can invest in denominations of 1 gm and are allotted gold bond certificates on allotment. At the hour of retrieval, they get the estimation of gold at the rate of simple average closing price for the past three business days. The investors receive a fixed predetermined rate of interest during the term of the bond. Whenever an SGB issue is opened, investors can apply for it at bank branches, post offices, SCHIL or authorised stock exchanges directly or through their agents.

Unique features of SGBs:

Fixed interest along with capital gains: The physical gold investment gives gains out of the price rise. No price rise, no profit. But the gold bond is the only method of gold investment which offers assured interest along with the price rise benefit.

No Expenses: For Sovereign Gold Bond Scheme gold ETF management companies have no charges where as about 1% of charge is spent for the fund value as the expense.

Government Guarantee, No Chance of Default: Conservative investors are important features. Government of India has issued secured gold bond.

Loan against Gold Bond: Investors can take a loan against the gold bond. It can be used as a pledge to get a cheap loan from the banks. The RBI has restricted banks and NBFCs to lend against the gold ETF and bullion. Till now the loan was given against the gold jewellery. The loan to value ratio of gold loan against jewellery would be also applicable for a gold bond.

Benefits of investing in Sovereign Gold Bonds are as follows:

1. Assurance of Safety: Govt of India Security
2. Zero Risk of handling Physical Gold
3. Easy Exit Options: Exit options and tradable on exchange is after 5 years.

On 8th June 2020, RBI has come up with Series III of Sovereign Gold Bond Issue 2020-21 offering Issue Price of Rs. 4,677 (with a discount of Rs. 50 for Online Mode). The Issue is open till 12th June 2020 and considered to be a huge opportunity for retail and HNI investors who are looking for Gold Investments.

Also, investment in Gold is a hedge tool and a trusted diversification investment option. Further, the risk of keeping physical gold in custody is eliminated by gold bond investment. The investment in Gold Bonds qualify for the equal appreciation which physical gold offers in long term and in addition to it. Sovereign Gold Bond offers 2.50% fixed interest rate per annum, making it more lucrative investment option.

The minimum amount an Individual can invest is1gm while maximum Limit is 4 Kg, while for Trust and Institutions the maximum Limit is 20 Kg. Bond Tenor is 8 years with an option to exit from 5th year onwards to be exercised on interest payment dates.

Also, the Bonds are tradeable on the Stock Exchange which adds on to the liquidity feature. The value of SGBs is linked to the price of physical gold. An investor can participate fully in any future movement in Gold price with a possibility of gains / losses from Gold price rise / fall respectively.

Transfer or sale of bonds before the redemption / maturity date is not exempt from Capital Gains Tax. Indexation benefits on long term capital gains shall, however, be available for such transfer / sale, if it qualifies as a long term capital gain.

Gold Exchange Traded Funds(Gold ETFs)

Gold Exchange Traded Funds, or Gold ETFs are mutual fund schemes, open-ended based on the ever-fluctuating cost of gold. The physical gold, on the other hand, does not generate an income. Also, the making charges on physical gold is high. Gold ETFs give investors exposure to the gold market. They are an excellent choice of investment for investors looking to beat inflation in the long-run. Moreover, gold as an asset is less volatile when compared to equities. 1 Gold ETF unit is equal to 1 gram gold. So, it gives the dual benefit of stock trading as well as gold investments. The fund management companies capitalise on gold bullion, and hence, they need to keep a close watch on the market performance. The value of Gold ETFs increases/decreases proportionally with the price of physical gold.

Units of gold ETFs are listed on the stock exchange and one can buy units from there. These are valued in line with the price of gold. To invest in gold ETFs, investors need to have a Demat account and a trading account.

Gold ETFs are suitable for investors who are looking to diversify their portfolio with exposure to the gold market. It is a low-risk investment which suits conservative investors. The money invested goes towards standard gold bullion of 99.5% purity. Even traded in the stock exchanges. Gold ETFs are consider low-risk investment. Individuals who do not wish to spend money on storage and additional taxes such as in the case of physical gold can also opt for gold ETFs.

Flexibility: Gold ETFs can be purchased online and placed in Demat account. The asset management company (AMC) is in charge for trading them on a stock exchange. One can enter/exit whenever required. In the Demat format and physical gold, gold ETFs behave the same.

Liquidity: Gold ETFs offer high liquidity as they can be traded in the stock exchange during a trading session at the prevailing price. Also, the transactional expenses (broker fee and government duty) is less than that of physical gold.

Smaller denomination: Approaching a retailer will need a large amount of money to purchase gold. However, in the case of gold ETFs, the advantage is to decide the quantum which an investor wish to buy and sell.

Ease of participation in the gold market: Investors acquire exposure to the gold market,with gold ETFs – a transparent,

safe platform and profitable. Also, they come with significant liquidity as gold can be traded instantly without any hassle.

Easy to hold for long: Gold ETFs do not levy wealth tax on Gold ETFs as opposed to physical gold. Storage (in Demat account) and safety are no issues either. Hence, investors can hold on ETFs for as long as they want.

Tax-efficiency: It offer a tax-friendly means to hold gold as the returns generated from Gold ETFs are subject to long-term capital gains tax.

Use of exchange platform (NSE): Gold ETF investors can use the stock exchange platform – National Stock Exchange (NSE) – to keep transactions and trade transparently.

Ease of transaction: Apart from listing and trading on the stock exchange, it can also be used as security for secured loans. Transactions are quicker and ease with exit load and zero entry .

Cost-effective: Gold ETFs do not make charges for physical gold like ornaments or bars. It can be purchased at international rates. Hence, there will be no mark-up at all.

Risk factors: The Net Asset Value of a gold ETF can go up or down as per the market trends. Similarly, the extra expenses like the fund manager's fee and others can impact the returns.

Investors are able to include an allocation to gold within a portfolio, either by gaining exposure to price movements of the gold, or by holding physical gold. There are many complex financial products that track the price of gold, and along with the rising interest in gold, there are also many ETFs that track the price movement of gold, either by using derivatives, or holding the commodity gold, i.e., physical gold traded as gold bullion. ETFs track the performance of an underlying benchmark, similar to an index fund, and are listed and traded just like a stock on exchange. Hence, ETFs are hybrids between regular stocks and mutual funds. ETFs make it easier for individual investors to gain exposure to many more alternative assets than it was possible before.

BOOK REVIEW

LANDSCAPE ARCHITECTURE

Author : Singh,Y.P

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The concept of landscape has been dealt with deeply by the author. Related concepts also have been interlaced suitably to make reading and comprehension easy. Sincere efforts to link associated fields of study like Archeology and Architecture to Landscape architecture highlighting their claims on both aesthetic and professional milieu is appreciable. References to several authors/ exponents, landscape and Organic architects and styles of gardens add ample provisions for knowledge sharing which has been effortlessly handled. Tracing the evolution of Landscape architecture - an exclusive field of study – and garden styles through Country-wise history receives special mention. Having incorporated architects of 18^{th} and 19^{th} Century and their masterpieces along with ancient historical development of architecture across the globe, the author has presented a good reference book for students of architecture, landscape architecture and those interested in arts in culture and history. A sequential approach to development of the subject has been vividly given in 19 Chapters. Linking landscape gardens with sustainable living citing C2C designs is quite laudable and has been handled very lively to introduce the reader and others too who are not aware of these concepts to a new and modern approach.

Inclusion of literature on temples remains an elusive concept as their purpose for inclusion has not been justified. Of course it is a concise treasure trove of architectural marvels of the ancient world in a literary format.

The book is published as a hardbound volume in 288 pages inclusive of Bibliography and Index. Many of the architectural masterpieces have been cited as black and white photographs but none of them (photographs) have been attributed.

When the whole world is reeling with establishment of Smart cities, landscape architecture as an essential element in the development of such cities gains significance. Considering this aspect, this book can be useful as a ready- reckoner for aspiring professionals in landscape management, urban city planning, nature conservation and public administration.

Visalakshi Rajeswari, S.

Research Highlights

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RESEARCH ARTICLES