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EDITORIAL

Fortis; The Journal published by MES College Marampally, has consistently affirmed its commitment to advancing scholarly pursuits by disseminating pertinent research articles across the domains of Science, humanities, and literature. The primary objective of this journal is to present novel findings, ensuring the widespread distribution of this knowledge within a diverse community that includes students, researchers, academicians, scientists, and literary experts.

In the pages of this Fortis issue, you will find research papers spanning the disciplines of Science, Social Science, and Law. Our dedicated efforts have been focused on crafting a coherent collection of articles, thoughtfully incorporating current trends and perspectives in the aforementioned fields. It is our sincere endeavor to provide a meaningful blend of content that reflects the dynamic nature of research in these disciplines.

Dr. Ajims P Mohammed
Chief Editor

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IMPACT OF YOGA ON MINDFULNESS: AN INTERVENTION STUDY WITH DIFFERENTLY ABLED CHILDREN

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Abstract. Based on the empirical research, this paper aims to explore the effectiveness of yoga on mindfulness with differently-abled children in the Ernakulam district. It seems and has been proved by some studies that yoga practice helped differently-abled people and their wellbeing. 25 differently-abled children were allocated for the study. Their experience of mindfulness was measured before and after eight yoga sessions. The result showed that respondents' experience of yoga sessions made a positive impact on children and also result indicated that the post-test experienced a significant increase in Overall mindfulness. These study results have an exclusive implication for using yoga sessions to change the wellbeing of differently-abled children.

Keywords: Yoga, Differently Abled Children, Mindfulness

INTRODUCTION

The word mindfulness comes from Smriti- a Sanskrit word that means "remembering". It is most commonly translated as "mindfulness." Buddhist meditation or Bhavana traditionally has two dimensions. They are

Shamathah and Vipassana (Pali: Samatha and Vipassana). The second aspect is highlighted most in Buddhist meditation that is, Vipassana is commonly known in the West as insight or mindfulness meditation (Boccio, 2005).

Avoiding a distracted or clouded state of mind is what mindfulness is all about. The ordinary or sensorial mind, as previously stated, is inherently outwardly driven, avoiding the inner locus of all our experience. The practice of mindfulness acts as a kind of mental restraint, increasing our efficiency and productivity. One concentrates the mind on what we are doing right now, whether it is interacting with others, working, studying, or cleaning the house. We can practice mindfulness no matter what we're doing. This is why Buddha described mindfulness as the only path to liberation from suffering. Mindfulness is simply the observation, on each moment and in a particular way, of the intellectual phenomena of our mind such as thoughts, feelings, perceptions, memory, and will or impulse. These mental phenomena in an unpredictable state cause complex process within us (Pradhan, 2015). This is referred to as the defilement response or unwholesome response. In physiological terms, it is similar to what we call the arousal response. This happens when these mental processes thought, feelings, etc. escape our awareness. When these mental phenomena are passed to observation, mindfulness diffuses them, saving the individual from defilement and unwholesome response (Bodhi, 2010). In this process, one relates through contemplation rather than feelings through sensory mental habits (e.g., attachment, repulsion, or apathy). Using all these phenomena as the objects of meditation helps profoundly to grasp how they rise like a wave, to enter one's awareness, and ultimately to dispel into an incessant stream of mindfulness.

This continuous awareness experience is quite distinct from the fragmented consciousness, under which our sensory mind usually operates. In contrast to a snap, it's like a movie. If your daily activities are guided by the knowledge gained from that continuous awareness of daily life, your actions are wise rather than the discharge of your impulses. That

is why it is said that mindfulness is a way of life. A way of being fully in the present moment. The word mindfulness itself is self-explanatory- mind Fullness. It means that filling the mind with the awareness of the present. Thus, it gets empty of distractions and unnecessary thoughts (Alexander, 2014). In meditative philosophy this is one fundamental wisdom: meditation is not confined to a prayer room; it is rather than meditation all life.

Several children suffer from stress, poor attention, and non-progressive damage to the infant's brain, resulting in motor and postural difficulties, poor social skills, behavioural problems, and anxiety. Mind-body therapies like mindfulness therapy, meditation, and yoga have been used to reduce and manage the psychological effects of stress and anxiety along with other physiological and social skill problems in many countries, according to the evidence. Hence the practice of yoga along with mindfulness meditation can make an effect on the holistic improvement of the children.

REVIEW OF LITERATURE

The selected review of pieces of literature is discussed below for understanding mindfulness and its growth in recent years. Works of literature are selected from journals, books, online materials, and newspapers.

The intervention of yoga as a meditative movement practice in helping schoolchildren manage stress and anxiety is the subject of this review article. All of the studies looked at included some kind of meditative movement exercise. Asanas (postures), Pranayama (life force expansion), Dharana (concentration), and Dhyana (meditation) were all included in the intervention. The results of this study show that yoga can help with stress management and anxiety reduction, among other things. Despite the heterogeneity and sample size limitations in most, if not all, of the studies reviewed, yoga appears to be an effective modality for helping children cope with stress and anxiety (Nanthakumar, 2018).

Mindfulness meditation has been shown to decrease activity and size in anxiety-related areas of the brain, such as the amygdala, as well as increase the size of the PFC and insular cortex, both of which control emotional regulation, in the long-term expert meditators. The functional connections between the amygdala and the PFC in these meditators have also been shown to be reduced, allowing for less reactivity to stressors. Yoga and mindfulness transform the mind, but these practices also change the brain in both its functions and structures. It was found in a study using mindfulness which showed an increase in regional gray matter density (Britta, 2011).

In an activation likelihood estimation meta-analysis conducted studies from traditions other than mindfulness meditation were included. The findings revealed a global medium effect size, with eight brain regions consistently altered in meditators: the front polar cortex, which the authors suggest may be linked to enhanced meta-awareness following meditation practice; the sensory cortices and insula, areas linked to body awareness; and the hippocampus, a memory-related region. The anterior cingulate cortex (ACC), mid-cingulate cortex, and orbitofrontal cortex, all of which are associated with self-and emotion regulation; and the superior longitudinal fasciculus and corpus callosum, both of which are involved in intra- and inter-hemispheric communication(Kieran, 2014).

The amygdala has been linked to the emotional processing of both positive and negative valence stimuli on numerous occasions. Previous research suggests that when a subject is in a meditative state of mindful attention, the amygdala response to emotional stimuli is reduced, both in beginner meditators after an 8-week meditation intervention and in expert meditators. However, when participants are in a non-meditative state, the longitudinal effects of meditation training on amygdala responses have not been reported. In this study, we looked at how 8 weeks of meditation training affects amygdala responses to emotional stimuli in non-meditative subjects.

Healthy adults who had never meditated took part in either Mindful Attention Training (MAT), Cognitively-Based Compassion Training (CBCT; a program based on Tibetan Buddhist compassion meditation practices), or an active control intervention for 8 weeks. Participants underwent an MRI experiment before and after the intervention in which they were shown images with positive, negative, and neutral emotional valences from the IAPS database while remaining in a normal, non-meditative state. We discovered a longitudinal decrease in right amygdala activation in the Mindful Attention group in response to positive images, as well as in response to images of all valences overall, using a region-of-interest analysis.

We discovered a trend in the right amygdala response to negative images in the CBCT group, which was significantly correlated with a reduction in depression score. In the control group, no effects or trends were observed. This finding suggests that meditation training's effects on emotional processing may be transferable to non-meditative states. This is in line with the theory that meditation training may induce learning that is process-specific rather than stimulus or task-specific, resulting in long-term changes in mental function (Gaelle, 2012).

YOGA AND DIFFERENTLY ABLED

A study was conducted to learn more about the effects of Yoga-mental rehearsal and adapted physical education on the self-concept of differently-abled children. A total of 90 differently-abled children were chosen for this study, with 30 children divided into three groups: amputation, poliomyelitis, and congenital deformity. Amritsar's All India Pingalwara Charitable Society provided these children. The people who took part in the study came from a variety of different families. Ninety children aged 14 to 18 years old with amputations, poliomyelitis, and congenital deformities were randomly assigned to one of three groups: Yoga mental rehearsal, Adapted physical education, or Control. A comprehensive review of the literature on the topic was conducted. Self-Concept was chosen as the psychological variable for research. ANCOVA

was adapted by using SPSS to determine the comparative effectiveness of yoga-mental rehearsal and adapted physical education on psychological variables of differently-abled children (Version, 19). A Post-Hoc test was used to determine the difference between the adjusted final means whenever an 'F' value was found to be significant. As a result, of the two treatments, Yoga-Mental Rehearsal is thought to be more effective in improving the Self-Concept of differently-abled children (Rautela & Singh, 2012).

Yoga has a lot of potential for helping differently-abled people get back on their feet. It was proven in a study conducted at the Vivekananda Kendra Yoga Research Foundation in Bangalore among mentally handicapped people. Yoga practice helped mentally challenged people to improve their mental abilities, as well as their motor coordination and social skills. After practicing yoga, physically disabled people were able to regain some functional ability. When visually impaired children practiced yoga for three weeks, their abnormal anxiety levels decreased significantly, whereas a physical activity program had no such effect (Telles, 1997).

The influence of yoga on mentally retarded children is proved very much positive in a study conducted in four special schools in Bangalore with mentally retarded children. Ninety children with mild, moderate, and severe mental retardation were chosen. Forty-five children were given an integrated set of yogic practices, including breathing exercises and pranayama, Sithilikaranavyayama (loosening exercises), Suryanamaskar, Yogasanas, and Meditation, for one academic year (5 hours per week). They were compared to a control group of 45 mentally retarded children who were not exposed to yoga training but continued their regular school routine during that time. They were matched for chronological age, sex, IQ, socioeconomic status, and socio-environmental background before and after yoga training. When the yoga group was compared to the control group, there was a highly significant improvement in IQ and social adaptation parameters. The efficacy of yoga as a therapeutic tool in the treatment of mentally retarded children is demonstrated in this study.

When applied to a group of ninety mentally retarded children, yoga helped produce a highly significant improvement in IQ and social adaptation, according to research published in the Journal of Mental Deficiency (Uma, 1989).

The loss of vision has an impact on the academic performance of visually impaired children. A pilot study was implemented to see how children with visual impairment improve their verbal recall memory after practicing a yogic module. The study involved 113 children from a Surat-based blind school who participated in a seven-hour yoga and pranayama workshop. Pranayama (breathing techniques), super brain yoga, and yoga Nidra were among the ancient techniques used in the intervention (supine relaxation). The Verbal Memory Rey Auditory Verbal Learning Test was used to assess verbal memory (RAVLT). Before and after the intervention, subjects were tested on verbal memory recall. Participants' retention and recall memory improved significantly after the intervention, according to the findings. Yoga has been proven to be a successful intervention for children with visual impairment. The goal of this study was to create, validate, and evaluate the feasibility of a yoga module designed specifically for children with visual impairment. Based on traditional and contemporary yoga literature and published studies, a yoga module was created to determine participant needs and yoga practices that could be effective. It was validated with 25 experts over two rounds of iteration, and the practices' feasibility was tested on nine children with visual impairment. The success of yoga practice was assessed using tennis ball throw and standing vertical jump tests.

The final yoga module included 30 yoga practices with a content validity ratio of less than 0.37. The final module, according to all experts, is technically simple to teach, learn, and practice. After the intervention, all of the children expressed 80% satisfaction with the yogapractices and the method used to teach them. The standing vertical jump score ($p = .585$) did not improve after the intervention, but the tennis ball throw score did ($p = .011$). The module's feasibility is supported by positive exit survey responses and high participation rates. The yoga module was validated for

children with visual impairment based on evidence from traditional knowledge and scientific studies. The module's feasibility was also successfully assessed, indicating that it can be used safely and effectively as an alternative training for people with visual impairment (Mohanty, 2019).

Further, a study was held to see if yoga had a positive impact on the self-esteem and emotional maturity of visually impaired students. A total of 15 visually impaired students were chosen at random from a School for the Blind. A four-week Yoga training program was devised, and the participants were exposed to it. The effects of yoga on visually impaired students' self-concept were assessed using Saraswat's Self-Concept Inventory, while emotional maturity was assessed using Yashvir Singh and Mahesh Bhargava's Emotional Maturity Scale. The data was analyzed using the mean, standard deviation, and t-test. Overall, the level of self-concept and emotional maturity of visually impaired students improves after practicing yoga, according to the findings. There were significant differences in mean gain scores on all dimensions of the Self-Concept Inventory and the Emotional Maturity Scale (Sandeep, 2013).

Due to irreversible damage to visual sensory input that contributes to balance, people with visual impairment (VI) are more likely to fall. By strengthening the remaining sensory systems, targeted training can help to improve postural stability. The Ashtanga-based Yoga Therapy (AYT) program is evaluated as a multi-sensory behavioural intervention for developing postural stability in VI. A single-blind, randomized, waitlist-controlled clinical trial. Twenty-one legally blind people were randomly assigned to either an 8-week AYT program (n = 11, mean (SD) age = 55(17)) or a waitlist control group (n=10, mean (SD) age = 55(10)). For a total of 8 weeks, AYT participants met for one group session at a local yoga studio with an instructor and two individual home-based practice sessions. At baseline and after 8 weeks of AYT, the subjects completed outcome measures.

The Wii Balance Board (WBB), a standalone post-urography device, was used to determine absolute Centre of Pressure (COP) in four sensory conditions: firm surface, eyes open (EO); firm surface, eyes closed (EC); foam surface, EO; and foam surface, EC. The relative visual (SI_{firm}, SI_{foam}), somatosensory (SIEO, SIEC), and vestibular (SIV, i.e., FoamEC vs. FirmEO) contributions to balance were determined using Stabilization Indices (SI) derived from COP measurements. Because this study lacked the power to detect differences between groups, the significance of pre-post changes was determined using paired samples t-tests within each group.

At the outset, the groups were comparable (all $p > 0.05$). Absolute COP increased significantly in the FoamEO ($t(8) = -3.66, p = 0.01$) and FoamEC ($t(8) = -3.90, p = 0.01$) conditions in the AYT group. Somatosensory SIEO ($t(8) = -2.42, p = 0.04$) and SIEC ($t(8) = -3.96, p = 0.01$) contributions to balance increased significantly, as did vestibular SIV ($t(8) = -2.47, p = 0.04$). As expected, there were no significant differences between the EO and EC conditions, indicating that VI is not visually dependent. The control group showed no significant pre-post changes (all $p > 0.05$). These preliminary findings show that AYT training can help a VI population develop the remaining somatosensory and vestibular responses that are needed to maintain postural stability (Jeter, 2015).

Cerebral Palsy (CP) is the most common physical disability in children, affecting 1.77 out of every 1000 kids. Even though cerebral palsy is primarily a physical disability, children with it are more likely to have cognitive problems, particularly attention and executive function deficits. Independent functioning, education, employment, and interpersonal relationships can all be harmed by cognitive impairment. The protocol for a randomized controlled trial of a novel family-centered lifestyle intervention based on mindfulness and hatha yoga. MiYoga is a program designed to help children with cerebral palsy and their parents improve their child's and parent's outcomes. The goal is to find 36 child-parent pairs (ages 6 to 16; bilateral or unilateral CP; Gross Motor Function Classification System I-III) who will be randomly assigned to one of two groups: MiYoga

or waitlist control. For the next eight weeks, the MiYoga program will be led in a group setting. Assessments will be given at the start of the study, before starting MiYoga, after finishing MiYoga, and at the 6-month follow-up (retention). The Conner's Continuous Performance Test II is used to assess the child's sustained attentional ability; other outcomes of interest for children with CP include attentional control, physical functioning, behavioural, and well-being. This study has proved that MiYoga offers a lifestyle intervention that improves attention in children with CP. Then, it could help children with CP and complement their ongoing therapy by improving the child's ability to pay attention in school and therapy, as well as reducing environmental stressors for both the child and his or her parents (Mak, 2017).

Visually Impaired (VI) mobility necessitates a higher level of proprioception. Yoga has been shown to improve proprioception in normally sighted children, so VI students may benefit as well. The purpose of this research was to see how yoga practice affected VI students' proprioception. On the 1st and 30th days, 54 VI students of both genders, aged 10–19 years, from two blind schools were assessed for proprioceptive function using a kin esthesiometer in a wait-listed two-armed-matched case-control study. The yoga group did a specific yoga module. There was no intervention in the control group. On all variables, the baseline data matched between groups. Within the yoga group, there was a significant decrease in proprioceptive sense measurement error scores at 20° and 120° positions of the right elbow, but there was no significant difference between the groups at 120° positions of the right elbow. Overall, the yoga group improved in all six positions measured, and their percentage improvements in all six positions were greater than the controls. Only three of the twelve t-tests were significant. The yoga module used could help VI children improve their proprioceptive function. More research is needed to fine-tune the details of this finding (Mohanty, 2014).

From the above-mentioned review of literature, it is clear that yoga can be used for wellbeing improvement in an individual, especially in children.

Yoga can help both the physical and mental state of people and improve their day-to-day functioning. There was a limited study in Kerala is the gap found from the above literature and this study aims to analyse the efficacy of yoga on the well-being of the differently-abled children: An intervention study based on mindfulness scale. The base objective of the study is to identify the impact of yoga on mindfulness with differently-abled children.

METHODOLOGY

This study used an experimental research design with a quantitative approach. A researcher wants to know the effectiveness of yoga on the well-being of differently-abled children. So, eight yoga sessions were implemented. The yoga intervention sessions contained a weekly yoga class for eight weeks. The yoga sessions combined a standard series of poses that were repeated in each class. Each class was 45 minutes long and was included yoga postures, breathing exercises, and Shavasana relaxation. The procedure of this experimental study used one group Pre-test and Post-test design. In this study, the researcher used the purposive sampling technique. The primary data source of this research was 25 differently-abled children from Ernakulam district. A pre-test was given before doing an experimental research study and a post-test was done after doing the treatment. The Freiburg Mindfulness Inventory (FMI) was used for measuring mindfulness effect on children and this scale consisted of 14 items. The study followed all the ethical considerations for selecting the sample and doing a study from the field.

RESULT AND DISCUSSION

The below table explains the pre and post-test of mindfulness characteristics from the FMI scale. This scale was in four points and this study consisted of 65% male respondents and 35% female respondents. The scale characters from the study are explained in detail with the help of table No: 1.

Table: 1 Pre and post-test of differently-abled children

Sl.No	Characteristic	Pre-test	%	Post-test	%
1	I am open to the experience of the present moment.	Rarely	30%	Rarely	15%
		Occasionally	15%	Occasionally	18%
		Fairly often	35%	Fairly often	22%
		Almost always	20%	Almost always	45%
		Total	100%	Total	100%
2	I sense my body, whether eating, cooking, cleaning, or talking.	Rarely	20%	Rarely	14%
		Occasionally	23%	Occasionally	8%
		Fairly often	17%	Fairly often	22%
		Almost always	40%	Almost always	56%
		Total	100%	Total	100%
3	When I notice an absence of mind, I gently return to the experience of the here and now.	Rarely	16%	Rarely	10%
		Occasionally	15%	Occasionally	12%
		Fairly often	25%	Fairly often	35%
		Almost always	44%	Almost always	43%
		Total	100%	Total	100%
4	I am able to appreciate myself.	Rarely	25%	Rarely	15%
		Occasionally	15%	Occasionally	22%
		Fairly often	20%	Fairly often	28%
		Almost always	40%	Almost always	25%
		Total	100%	Total	100%

5	I pay attention to what's behind my actions.	Rarely	35%	Rarely	15%
		Occasionally	25%	Occasionally	30%
		Fairly often	30%	Fairly often	20%
		Almost always	10%	Almost always	35%
		Total	100%	Total	100%
6	I see my mistakes and difficulties without judging them.	Rarely	10%	Rarely	25%
		Occasionally	20%	Occasionally	40%
		Fairly often	40%	Fairly often	20%
		Almost always	30%	Almost always	15%
		Total	100%	Total	100%
7	I feel connected to my experience in the here-and-now.	Rarely	50%	Rarely	25%
		Occasionally	25%	Occasionally	20%
		Fairly often	10%	Fairly often	35%
		Almost always	15%	Almost always	20%
		Total	100%	Total	100%
8	I accept unpleasant experiences.	Rarely	15%	Rarely	20%
		Occasionally	25%	Occasionally	15%
		Fairly often	40%	Fairly often	25%
		Almost always	20%	Almost always	40%
		Total	100%	Total	100%

9	I am friendly to myself when things go wrong.	Rarely	35%	Rarely	15%
		Occasionally	25%	Occasionally	25%
		Fairly often	20%	Fairly often	25%
		Almost always	20%	Almost always	35%
		Total	100%	Total	100%
10	I watch my feelings without getting lost in them.	Rarely	25%	Rarely	10%
		Occasionally	35%	Occasionally	20%
		Fairly often	25%	Fairly often	30%
		Almost always	15%	Almost always	40%
		Total	100%	Total	100%

There is collective information nowadays, around how mindfulness and mindfulness practice can help to advance the mental and physical health of individuals. It is defined as the capability to be completely aware of all the experiences which are handled inside the self-body and also in the external world which comprises the events and persons in the environment. As defined in the literature sections, mindfulness has been well-known as an important feature for children, especially differently-abled children.

From the above table no. 1, it is clear that yoga increased the levels of mindfulness in differently-abled children. Mindfulness was assessed pre- and post-yoga, using an FMI scale 14 items. The pre-test was conducted and resulted in a low level of mindfulness in children. The 14 items were scored low percentage. So, the study entered its second stage by intervention strategy and took the data once again. There found a difference from the pre-test. Post-test showed a significant percentage and it helped their overall well-being. The significant difference in the percentage level of pre-test and post-test are clear and showcase the effect of yoga on mindfulness.

The above data suggest that a yoga intervention had a significant influence on the characteristic of mindfulness. The characters in scale demonstrating the utmost significant change in the yoga intervention was the attention to the disidentifying attentional processes of mindfulness inventories, which measures the ability to pay attention to the present moment without distraction. Yoga has been employed as a vehicle for sustaining a healthy lifestyle for five thousand years. The specific ways in which yoga keeps us healthy are becoming more important as we search for different paths of promoting a prevention model of healthcare. Nowadays mindfulness is used to reduce stress, depression, anxiety, and pain. Due to the existing relationship between mindfulness and improved health, yoga may be a straight avenue for locating improved physical and psychological health, as well as affect guidelines, mediated by mindfulness practices.

This study demonstrates that there is an influence of yoga on mindfulness. This study results also tell us about the voluntary effort of children, even

though they are facing a differently abled situation in their life. Due to the covid 19 outbreak, this study only focused on 25 differently-abled children. But future research can be conducted with more respondents and also this study has only one group of respondents. In the future studies can be conducted with the control group and experimental group. This study never tests a hypothesis and this study only focused on yoga on mindfulness and how it is working with differently-abled children. So, the upcoming study can be conducted with different respondents' groups.

In conclusion, the levels of mindfulness vary between pre-test and post-test results of differently-abled children. Mindfulness yoga sessions improve mindfulness and some other aspects of wellbeing. Mindfulness yoga sessions had positive impacts on sleep, stress, and attention of differently-abled children.

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REFERENCES

1. M. Alexander Simpkins, *The Yoga and Mindfulness Therapy Workbook*. (Eau Claire: PESI Publishing & Media, 2014)
2. F. J. Boccio, *Mindfulness yoga-The Awakened Union of Breath, Body, and Mind*. (Boston: Wisdom Publications, 2005).
3. B. Bodhi, *The Noble Eightfold Path: a way to the end of suffering*. (Onalaska: Pariyatti Publications, 2010).
4. J. M. Britta K. Hölzel, *Mindfulness practice leads to increases in regional brain gray matter density*. (Psychiatry Research: Neuroimaging, 36-43. 2011).
5. ChandraNanthakumar, *The benefits of yoga in children* (Journal of Integrative Medicine, 14-19, 2018).
6. L. T. Gaëlle Desbordes, *Effects of mindfulattention and compassion meditation training on amygdala response to emotional stimuli in an ordinary, non-meditative state*, (Frontiers in Human Neuroscience, 292, 2012).
7. H. M. Jeter PE, *Ashtanga-Based Yoga Therapy Increases the Sensory Contribution to Postural Stability in Visually-Impaired Persons at Risk for Falls as Measured by the Wii Balance Board: A Pilot Randomized Controlled Trial* (PLoS One., 6-10, 2015).

8. S. N Kieran C R Fox, *Is meditation associated with altered brain structure? A systematic review and meta-analysis of morphometric neuroimaging in meditation practitioners* (Neuroscience and biobehavioral reviews, 48–73, 2014).
9. C. W. Mak, *yoga: a randomized controlled trial of a mindfulness movement program based on hatha yoga principles for children with cerebral palsy: a study protocol.* (BMJ Open, 1-17, 2017)
10. S, V. S. Mohanty, *Development and validation of a yoga module for children with visual impairment: A feasibility study*, (British Journal of Visual Impairment, 64-73, 2019).
11. S. P. Mohanty, *The effect of yoga practice on proprioception in congenitally blind students* (British Journal of Visual Impairment, 124–135, 2014).
12. B. Pradhan, *Yoga and Mindfulness-Based on cognitive Therapy.* (London: Springer, 2015).
13. A Rautela, & A. P Singh, *Comparative effect of yoga -mental rehearsal and adapted physical education program on the self-concept of differently-abled children.* (International Journal of Sports Sciences & Fitness, 269-276, 2012).
14. S. G. Sandeep Berwal, *Effect of yoga on Self-concept and emotional maturity of visually challenged students: An experimental study*, (Journal of the Indian Academy of Applied Psychology, 260-265, 2013).
15. S, N. K. Telles, *Yoga for rehabilitation: an overview*, (Indian J Med, 123-127, 2012).
16. K, N. H. Uma, *The integrated approach of yoga: a therapeutic tool for mentally retarded children: a one-year controlled study*, (J Ment Defic Res, 415-21, 1989).

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A REVIEW ON THE PROSPECTIVE APPLICATIONS OF FUNGAL KERATINASES

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Abstract: Keratin is the most abundant insoluble protein in the epithelial cells of vertebrates and represents the major constituents of skin, hair, feathers, wool, and nails. It is among the hardest-to-degrade animal protein, the major component in poultry feathers. Keratinases are exciting proteolytic enzymes that display the capability to degrade the insoluble protein keratin which are recalcitrant to the commonly known proteolytic enzymes trypsin, pepsin and papain. Keratinases are versatile enzymes gaining momentum in the field of Biotechnology with potential applications. As the keratin is too hard to degrade, substrates like hair, hoof, horn, feather nail etc. can be treated with keratinases, which is considered as an outstanding application of the enzyme. The utilization of poultry feathers using keratinase improve the nutritional value of feather meal and can be used for the production of rare amino acids such as cysteine, serine, proline and methionine. The promising application of keratinolytic enzymes have been associated with cosmetic industry and acne treatment. The other applications of keratinase include production of biofuel, detergent, films, coatings, glues and pesticidal toxins, degumming of silk, Scale removal from wool fibre, degradation of prions etc. Keratinases are largely produced by diverse microorganisms like bacteria and fungi which are considered as biodegradable, eco-friendly enzymes without any harmful effects when compared to chemical counterparts. As the separation of bacterial keratinase is a cost intensive process compared to fungal keratinase, the review is focussed on isolation, purification and prospective applications of fungal keratinase.

Keywords: Keratinase, Keratin, Fungus, Hair & Protease.

INTRODUCTION

The term 'keratin' stood for all of the proteins extracted from skin modifications, such as horns, claws and hooves. Subsequently, it was realized that this keratin is actually a mixture of keratins, keratin filament-associated proteins and other proteins. The protein chains are packed tightly either in α -chain (α -keratins) or in β -sheet (β -keratins) structures. Keratins belong to the superfamily of intermediate filament proteins and their high degree of cross-linking by disulfide bonds, hydrophobic interactions, and hydrogen bonds stabilizes keratin filament structure (Fuchs, 1995). Therefore, keratinous material is water insoluble and extremely resistant to degradation by proteolytic enzymes such as trypsin, pepsin, and papain. In human hair, keratin is present as α -keratin and in bird feathers as β -keratin (Kelly *et al.*, 2006). The daily accumulation of feather wastes from poultry farms, hair, hoof, horn, nail etc. are poorly recycled in nature and the disposal of these wastes is a global environmental issue leading to pollution of both air and underground water resources (Lin, 1992). There is a growing trend to apply cheap and environment-friendly methods to recycle keratinous wastes. A group of proteolytic enzymes which are able to hydrolyze insoluble keratins more efficiently than other proteases are called keratinases (Onifade, 1998).

Keratinases [EC.3.4.99.11] belong to the group of serine proteases capable of degrading keratin. There are many reports on the isolation and identification of keratinases from different microbial sources. Keratinases can be produced by several species of fungi, bacteria and actinomycetes. The microorganisms from which keratinase isolated include fungi viz. *Peaciliomyces marquandii* and *Doratomyces microspores Fusarium*, *Acremonium*, *Geotrichum* (Friedrich *et al.*, 2005) and *Trichophyton mentagrophytes* (Okafur, 2000; Muhsin, 2002). The commercial application of enzymes greatly depends on the cost of the enzyme which again is determined by the production cost of the enzyme. Currently most commercially available enzymes are produced through cost intensive submerged fermentation (SmF). An alternative method for the growth of microorganisms which is currently receiving significant attention is solid state fermentation (SSF). Solid state fermentation (SSF) is the growth of microorganisms on solid substrates without the presence of free-flowing water content. Keratinases have tremendous applications in various areas

including waste management, production of biofuel, detergent, films, coatings, glues and pesticidal toxins, degumming of silk, Scale removal from wool fibre, degradation of prions etc.

SCREENING AND ISOLATION OF KERATINOLYTIC FUNGI

The keratinophilic nature of the fungi makes them easy to isolate using Vanbreuseghem's hair bait method. The isolation of keratinases producing fungi was carried out using hair bait technique. (Vanbreuseghem, 1952). *Chrysosporium gorgiae* was isolated from chicken feathers using hair baiting technique. Isolation of keratinophilic fungi can also be done by the other techniques such as the dilution plate method or pour plate method although the hair baiting method is better as the keratinolytic ability is automatically checked if the fungus grows on the de-fatted natural keratin substrate. Once the fungus grows on the keratin substrate in the hair baited plate it can then be transferred onto agar media as these fungi generally can grow on various artificial media. Except for some of the unusual strains which have special nutritional requirements, almost all the keratinolytic fungi grow on most artificial media, and Sabouraud's Dextrose Agar is widely preferred for maintaining these fungi in the laboratory. Since some keratinolytic fungi can be pathogenic to humans and other animals, special care is required during their isolation and maintenance (Sharma and Rajak, 2003). Screening of keratinolytic fungus is done in keratin medium on which they form zone of clearance. Isolation of keratinolytic fungi on feather meal medium was described by Venkita Saibabu *et al.*, (2013). Isolation of keratinolytic fungi from various sources using medium containing feather powder has been reported by Awasthi and Kushwaha (2011). Media containing bovine hair has been reported by Galarza *et al.*, (2004).

METHODS OF ENZYME PRODUCTION

Submerged fermentation is the commonly employed method for the production of commercially important enzymes from bacterial sources. Recently, solid-state fermentation (SSF) has been receiving more attention. For the production of enzymes from fungal sources SmF and SSF are employed.

SUBMERGED FERMENTATION

Submerged fermentation is the cultivation of microorganisms in liquid media. Industrial enzymes can be produced using this process. This

involves growing carefully selected microorganisms (bacteria and fungi) in closed vessels containing a rich broth of nutrients (the fermentation medium). SMF has its own advantages and drawbacks. Serious pollution problems, low product concentration and high production cost are the major draw backs associated with the use of SMF. At present, more than 90 % of the commercial microbial enzymes including alkaline proteases are produced using submerged fermentation (Underkofler *et al.*, 1958; Aguilar *et al.*, 2008).

SOLID-STATE FERMENTATION

Solid state fermentation (SSF) can be elaborated as a fermentation process conducted basically by culturing microorganisms on a solid support in either complete or near absence of free-flowing water. SSF can also employ an inert material as solid matrix, which requires supplementing a nutrient solution containing necessary nutrients as carbon source and enough moisture. Solid state fermentation is mainly preferred for fungal enzyme production, due to the low moisture requirements of fungus when compared to bacteria (Chutmanop *et al.*, 2008).

PURIFICATION AND CHARACTERIZATION OF KERATINASE

The purification procedures are designed based on the molecular size, electrostatic stability and relative solubility in salts until purification homogeneity is achieved. The conventional methods involved in the purification of fungal keratinase are ammonium sulphate precipitation, ion exchange chromatography, affinity chromatography, gel filtration etc. Ammonium sulphate precipitation is economical and useful as the first step in the purification. It is a convenient and non-denaturing method. Affinity chromatography is a procedure involving a specific interaction between the protein of interest and the affinity matrix. Gel filtration chromatography separates molecules according to their size. Smaller molecules are able to enter the pores of the media and, therefore, molecules are trapped and removed from the flow of the mobile phase. Ion exchange chromatography uses an ion exchange mechanism to separate analytes based on their respective charges.

FUNGAL SOURCES FROM WHICH KERATINASE ENZYME HAVE BEEN ISOLATED & PURIFIED

Keratinases from *Penicillium* sp. Morsy I and *A. flavipes* have been purified by ammonium sulphate precipitation, ion exchange chromatography and

gel filtration chromatography in sequence. The enzyme produced by *A.parasiticus* was purified to homogeneity by acetone and ammonium sulphate precipitations followed by CM-Sepharose column chromatography (Anitha & Palanivelu, 2013). Fungal alkaline keratinase from *Cunninghamella echinulata* was purified by acetone fractionation followed by affinity chromatography (Sunil More *et al.*, 2013). Enzyme produced by *Chrysosporium keratinophilum* was partially purified by acetone precipitation followed by gel filtration on Sephadex G-75

CHARACTERIZATION

Keratinases are proteases and are characterised based on the presence of residues on their active site. The various keratinases can be characterised by identifying and studying their active sites. Keratinases are mostly serine proteases. (Bressollier *et al.*, 1999) They are metalloproteases also with keratinolytic property (Farang *et al.*, 2004). Serine proteases (EC. 3.4.21) are characterised by the presence of a serine residue in the active site of the enzyme and are dependent on a serine residue for catalytic activity.

APPLICATIONS OF KERATINASES

Keratinase producing microorganisms and microbial keratinase have broad prospect of applications.

UTILIZATION OF WASTES

The poultry industry produces vast number of wastes, particularly litter. Feather waste is β -keratin protein which cannot be degraded easily by proteolytic enzymes. Feathers generated from the poultry industry are to a limited extent used as a dietary supplement for animal feed, and feather meal (Papadopoulos, 1985). Submerged fermentation of poultry waste by microorganism producing keratinase helps in the conversion of non-soluble keratin (feather) into soluble protein or polypeptide (Suntornsuk and Suntornsuk, 2003). Keratinase can enhance the nutritional value of feather meal. The utilization of poultry feathers as a fermentation substrate by keratin-degrading microorganism or enzymatic biodegradation may be a better alternative to improve their nutritional value and to diminish environmental wastes.

BIO FERTILIZER PRODUCTION

Composting is the most economical and environmentally safe method of recycling feather wastes. Currently feather waste is utilized on limited basis

as a source of nitrogen for plants. Feathers contain approximately 15% N and can be used as a Nitrogen fertilizer. (Ichida *et al.*, 2001). Wastes of bovine hooves and horns were enzymatically hydrolysed by the enzyme from *Poecilomyces marquandii* into soluble products intended for foliar fertilization with the powdered keratin.

COSMETIC INDUSTRY

The promising application of keratinolytic enzymes has been associated with cosmetic industry. The primary defect in acne is thought to be that there is too much keratin produced at the exist of the hair shaft. This blocks the surface and does not allow the sebum out. So, the development of acne occurs. Keratinase is included in facial scrubs, and it is useful for treating acne, because dead cells can clog pores and create a favourable environment for acne.

Leather Industry

In order to overcome the hazards caused by the tannery effluents, the use of enzymes as a viable alternative to chemicals has successfully been resorted to in improving leather quality and in reducing environmental pollution Keratinase has emerging application in dehairing process in leather industry instead of sodium sulphides. Keratinase hydrolysed the outer epithelial sheath of hair roots provoking depilation. Effective dehairing property of *Paenibacillus woosongensis* TKB2 was observed by the SSF process by (Paul *et al.*, 2013).

DEPILATION PROCESS IN WOOL PROCESSING

A combined treatment method by utilizing the enzymes cutinase, keratinase and protease is applied in the wool processing to enhance the quality of wool. The combined action of these enzymes on wool obviously improves the wetability and antifelting property of wool fabrics. Keratinase could reduce the high degree of cross linking in keratinous proteins and make the proteolytic process occurring on the wool surface easily (Wang *et al.*, 2011)

THERAPEUTIC USES

Dermatophytosis or ringworm is a clinical condition caused by fungal infection of the skin in humans, pets such as cats, and domesticated animals such as sheep and cattle. The fungi that cause parasitic infection (dermatophytes) feed on keratin, which is found in the outer layer of skin,

hair and nails. Thus, a great deal of attention has been focused on keratinolytic protease (keratinase) as a possible agent for treatment of dermatophytosis.

PRODUCTION OF FILMS, COATINGS AND GLUES

There is an increased interest in the conversion of keratins into biodegradable films and coatings for both agricultural and biomedical applications. Keratin is chemically or enzymatically treated and the resulting modified keratin is converted into products for compostable packaging, agricultural films, or edible film applications (Zaghloul *et al.*, 2004). Polyethylene-based composites have been prepared using keratin fibres obtained from chicken feathers (Barone and Schmidt, 2005).

PRODUCTION OF ANIMAL FEED

It is observed that the chickens fed with keratinase enzyme grow to optimal weight quicker and need less feed to grow to that optimal weight. This is possibly because the enzyme thus can provide the same benefit in feed that antibiotics currently provide. (Jason Shih, 2004). It acts as an animal feed supplement and has other applications like waste treatment process. It promotes enhanced digestibility and efficiency of chicken feed which result in fast rate of growth in small quantity of feed.

AMINOACID PRODUCTION

In addition to the improvement of feather meals, the enzyme can be used for production of rare amino acids such as cysteine, serine, proline, and methionine (Kumar and Takagi, 1999; Riffel *et al.*, 2007). This enzymatic process is advantageous over commercial methods as large amounts of salts that need to be separated from the product would not be produced (Korkmaz and Dincer, 2004).

AS DETERGENT

Keratinases are used as desirable detergent additives which could replace the traditional proteases for removal of keratinous soils that are often encountered in laundry, such as collar washings to remove scurf and for eliminating horny epithelial cells adhered to textile fibres (Gupta & Ramnani, 2006 and Brandelli *et al.*, 2010). Keratinases have the ability to bind and hydrolyze solid substrates like feather. This is an important property of detergent enzymes for hard-surface cleaning. An extended application of keratinases in detergents is their use as additives for

cleaning up of drains clogged with keratinous wastes (Sareen & Mishra, 2008).

BIOFUEL PRODUCTION

Their use in biomass conversion into biofuels may address the increasing concern on energy conservation and recycling (Brandelli *et al.*, 2010) Over 5% of the chicken has feathers with alpha or beta keratin. This material can be recycled into useful products and it would have great commercial value.

PRION DEGRADATION

Infective prion protein is the agent responsible for prion diseases in human and animals. It finds application in more recent fields such as prion degradation for treatment of the dreaded mad cow disease (Langeveld *et al.*, 2003). This discovery indicated the potential use of keratinase in a new enzymatic process to destroy prion protein and possibly prevent TSE (transmissible spongiform encephalitis).

INDICATORS OF HYDROCARBON CONTAMINATION AND BIOREMEDIATION

Keratinolytic fungi are potential tools for the assessment of soil petroleum hydrocarbon contamination and associated bioremediation. Studies revealed that the keratinolytic fungi can remove hydrocarbons from different media. In pure culture, these fungi were able to remove hexane, toluene, hexadecane, pristane from media. The hydrocarbon removal process was much more effective when hair or peptone was added to the media.

PRODUCTION OF PESTICIDAL TOXINS

Keratinase gene from *Aspergillus fumigatus* has been successful in destroying the larvae of an agricultural pest, *Spodoptera frugiperda*, by degrading extracellular matrix proteins and interfering with the phenol oxidase activity of the insect host (Gramkow *et al.* 2010).

SILK DEGUMMING

Keratinolytic alkaline proteases produced by *Bacillus licheniformis* RG1 property are important instruments for degumming of silk. Sercin is the protein component responsible for silk compactness. Silk treatment with alkaline protease is known to reduce compactness and value smoothness to the silk (Johnny *et al.*, 2012).

SCALE REMOVAL FROM WOOL FIBRE

Wool fibre exhibit felty and shrinking feature because of the presence of scales that are found toward fibre tips. Conventionally, Chlorine- Hercosett is applied to remove the scales by oxidation, or coating of fibre in polymers used. Wool treatment with hair and keratin degrading alkaline protease provide an option in the removal of scale tips from wool fibre (Macedo, 2005). Significant structural changes and high levels of free amino acids from wool decomposition by *Stenotrophomonas maltophilia* BBE11-1 indicated the possible applications for wool waste management and fertilizer industry. The remarkable digestion of wool cuticle also suggested its potential utilization in textile industry.

OTHER POTENTIAL APPLICATIONS OF KERATINOLYTIC PROTEASES

Keratinase from *Streptomyces gulbargensis* is used for removal of some polluting metals such as calcium, magnesium, iron and manganese from polluted industrial wastewater by immobilization of active amino acids found in hydrolysate solution on silica surface as regenerable sorbents (Sayed *et al.*, 2005. The organic colloidal solution obtained as hydrolysis product of hoof and horn can be used as firefighting composition (Datta, 1993). Oxidation of keratinous materials cleaves and oxidizes some of the disulfide linkages to form water soluble peptides and this material is used as a wound healing agent. Keratin hydrolysates may be used in medicine for producing preparations to aid healing of wounds. Hydrolysates obtained using keratinolytic proteases can be used to regulate hemostasis and nerve regeneration.

CONCLUSION

This paper focused on keratin degrading microorganisms specifically fungus, its isolation, production of keratinolytic enzymes, purification and potential applications. Keratinases have found their applications in diverse sectors. The promising application of keratinolytic enzymes has been associated with cosmetic industry and acne treatment. The other applications of keratinase include production of biofuel, detergent, films, coatings, glues and pesticidal toxins, degumming of silk, Scale removal from wool fibre etc. The property of keratinolytic enzymes in hydrolysis of infectious prion proteins has enthused a novel research area. Substitution of chemical agents with fungal keratinase has been stressed because in comparison to chemicals, keratinase enzymes are eco-friendly,

biodegradable, do not produce harmful by-products and give very efficient results.

REFERENCES

1. Aguilar, C. N., Gutierrez-Sanchez, G., Rodríguez-Herrera, R., Martínez-Hernandez, J. L., & Contreras-Esquivel, J. C. (2008). Perspectives of solid state fermentation for production of food enzymes. *American journal of biochemistry and biotechnology*, 4(4), 354.
2. Anitha, T. S., & Palanivelu, P. (2013). Purification and characterization of an extracellular keratinolytic protease from a new isolate of *Aspergillus parasiticus*. *Protein expression and purification*, 88(2), 214-220.
3. Awasthi, P. and Kushwaha R.K.S, (2011). Keratinase Activity of Some Hyphomycetous Fungi from Dropped Off Chicken Feathers, *International Journal of Pharmaceutical & Biological Archives*; 2(6):1745-1750.
4. Barone, J. R., & Schmidt, W. F. (2005). Polyethylene reinforced with keratin fibers obtained from chicken feathers. *Composites Science and Technology*, 65(2), 173-181.
5. Brandelli, A., Daroit, D. J., & Riffel, A. (2010). Biochemical features of microbial keratinases and their production and applications. *Applied microbiology and biotechnology*, 85(6), 1735-1750.
6. Bressollier, P., Letourneau, F., Urdaci, M., & Verneuil, B. (1999). Purification and characterization of a keratinolytic serine proteinase from *Streptomyces albidoflavus*. *Applied and Environmental Microbiology*, 65, 2570–2576.
7. Chutmanop, J., Chuichulcherm, S., Chisti, Y., & Srinophakun, P. (2008). Protease production by *Aspergillus oryzae* in solid-state fermentation using agroindustrial substrates. *Journal Of Chemical Technology & Biotechnology*, 83(7), 1012-1018.
8. Datta, M. S. (1993). Role of keratin in fire fighting. *J Ind Leath Technol Assoc*, 43, 297-299.
9. Farag, A., & Hassan, M. (2004). Purification, characterization and immobilization of a keratinase from *Aspergillus oryzae*. *Enzyme And Microbial Technology*, 34(2), 85-93.
10. Friedrich, J., Gradisar, H., Vrecl, M., Pogaenik, A.(2005). *In vitro* degradation of porcine skin epidermis by a fungal keratinase of *Doratomyces microsporus*. *Enzyme Microb Technol*, 36, 455–460.

11. Fuchs, E. (1995). Keratins and the Skin. *Annual Review of Cell And Developmental Biology*, 11(1), 123-153.
12. Galarza, B. C., Goya, L. M., Cantera, C. S., Garro, M. L., Reinos, H. E., & López, L. M. I. (2004). Fungal biotransformation of bovine hair. Part 1: Isolation of fungus with keratinolytic activity. Partial characterization of crude fungal extracts. *Journal of the Society of Leather Technologists and Chemists*, 88(3), 93-98.
13. Gramkow AW, Perecmanis S, Sousa RL, Noronha EF, Felix CR, Nagata T, Ribeiro BM (2010) Insecticidal activity of two proteases against Spodoptera frugiperda larvae infected with recombinant baculoviruses. *Virology* 50:143.
14. Johnny, V. A., & Chinnammal, S. K. (2012). Degumming of silk using protease enzyme from *Bacillus* species. *International Journal of Science & Nature*, 3(1), 51-59
15. Ichida, J.M., Krizova, L., Lefevre, C.A., Kerner, H.M., Elwell D. L., & Burt Jr., E.H. (2001). Bacterial inoculum enhances keratin degradation and biofilm formation in poultry compost. *J. Microbiol. Methods*, 47, 199-208.
16. Kelly, G.C., Agbogbo, F. K. and Holtzapfel, M.T. (2006) Lime treatment of keratinous materials for the generation of highly digestible animal feed Animal hair. *Bioresource Technol*, 97, 1344–1352.
17. Korkmaz, H., Hür, H., & Dinçer, S. (2004). Characterization of alkaline keratinase of *Bacillus licheniformis* strain HK-1 from poultry waste. *Ann Microbiol*, 54(2), 201-211.
18. Kumar, C. G., & Takagi, H. (1999). Microbial alkaline proteases: from a bioindustrial viewpoint. *Biotechnology advances*, 17(7), 561-594.
19. Langeveld, J. P., Wang, J. J., Van de Wiel, D. F., Shih, G. C., Garssen, G. J., Bossers, A., & Shih, J. C. (2003). Enzymatic degradation of prion protein in brain stem from infected cattle and sheep. *Journal of Infectious Diseases*, 188(11), 1782-1789.
20. Lin, X., Lee, C. G., Casale, E. S., & Shih, J. C. (1992). Purification and characterization of a keratinase from a feather-degrading *Bacillus licheniformis* strain. *Applied and Environmental Microbiology*, 58(10), 3271-3275.
21. Macedo, A. J., da Silva WOB, Gava, R., Driemeier, D., Henriques JAP, & Termignoni, C. (2005). Novel keratinase from *Bacillus*

- subtilis* S14 exhibiting remarkable dehairing capabilities. *Appl Environ Microbiol*, 71(1), 594–596.
22. Muhsin, T.M. & Hadi, R.B. (2002) Degradation of keratin substrates by fungi isolated from sewage sludge. *Mycopathologia* 154 (4), 185-189.
 23. Okafur, JI & Ada, N (2000). Keratinolytic activity of five human isolates of the dermatophytes. *J. Commun. Dis.* ,32, 300-305.
 24. Onifade, A., Al-Sane, N., Al-Musallam, A., & Al-Zarban, S. (1998). A review: Potentials for biotechnological applications of keratin-degrading microorganisms and their enzymes for nutritional improvement of feathers and other keratins as livestock feed resources. *Bioresource Technology*, 66(1), 1-11.
 25. Papadopoulos, M. C. (1985). Amino acid content and protein solubility of feather meal as affected by different processing conditions. *Neth. J. Agric. Sci* ,33, 317–319.
 26. Paul, T., Halder, S. K., Das, A., Bera, S., Maity, C., Mandal, A., & Mondal, K. C. (2013). Exploitation of chicken feather waste as a plant growth promoting agent using keratinase producing novel isolate *Paenibacillus woosongensis* TKB2. *Biocatalysis and Agricultural Biotechnology*, 2(1), 50-57.
 27. Sayed, S. A., Saleh, S. M., & Hasan, E. E. (2005). Removal of some polluting metals from industrial water using chicken feathers. *Desalination*, 181(1), 243-255.
 28. Sharma, R., & Rajak, R. C. (2003). Keratinophilic fungi: Nature's keratin degrading K. Wawrzkievicz, T. Wolski and J. Lobarzewski, 1991 Screening the keratinolytic activity of dermatophytes in vitro, *Mycopathologia*, 114, 1–8 machines!. *Resonance*, 8(9), 28-40.
 29. Shih, J. C. H., Odetallah, N. H., Fosnaught, M. H., Wang, J. J., & Garlich, J. D.(2004). Growth performance of male broiler chicks fed low CP diets supplemented with Versazyme up to 28 days of age. *Poultry Science* 83 (Suppl. 1), 125
 30. Suntornsuk, W., & Suntornsuk, L. (2003). Feather degradation by *Bacillus* sp FK 46 in submerged cultivation. *Bioresour. Technol*, 86, 239-243.
 31. Underkofler, L. A., Barton, R. R., & Rennert, S. S. (1958). Production of microbial enzymes and their applications. *Applied microbiology*, 6(3), 212.

32. Vanbreuseghem, R.(1952). Technique biologique pour l'isolement des dermatophytes du sol. *Ann. Soc. Beige Med. Trop.*, 32, 173-178.
33. Venkata Saibabu, Francois Niyongabo Niyonzima and Sunil S. More (2013). Isolation, Partial purification and Characterization of Keratinase from *Bacillus megaterium*. *International Research Journal of Biological Sciences Vol. 2(2)*, 13-20.
34. Wang J-J, Shih HJC (1999) Fermentation production of keratinase from *Bacillus licheniformis* PWD-1 and a recombinant *B. subtilis* FDB-29. *J Ind Microbiol Biotechnol* 22:608–616.
35. Zaghloul, T. I., Haroun, M. A., El-Gayar, K., & Abdelal, A. (2004). Recycling of keratin-containing materials (chicken feather) through genetically engineered bacteria. *Polymer-Plastics Technology and Engineering*, 43(6), 1589-1599.

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ROLE OF MEDIA AND COURT IN THE PROTECTION OF DEMOCRACY

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Abstract. Media and judiciary are complimentary to each other that they both view man as the center of the universe. While the media investigates, unearths and exposes the human achievements and follies, the judiciary deals with the legal issues that man has brought about. The judiciary and the media share a common goal; to seek the truth, defend democratic ideals, and address social, political and economic issues. In fact, the judiciary has been referred to be the dispenser of justice and the engine for social reforms, while the media has been described as the watchdog of society and the handmaiden of justice. Consequently, both are necessary for the development of a civic society. Publicity before the trial is harmful to the integrity of a fair trial.

INTRODUCTION

Liberty, equality and justice through democratic political systems forms the present-day global society. However, to what extent shall nations be open to liberty and equality is a key question to be thought about. The major idea of democracy is to receive and impart information that is

processed or as is. A balance is always preferable or sought between liberties or freedoms with the democratic guarantees. And in such a democratic system the media play a pivotal role in keeping the citizens and the public abreast of the nation's progress or the political status in order to enable to help them make informed choices and decisions. With the evolution of the media into a place where public can participate is whether media serves the interest of the public in actual or there is a narrowing of interests in order to cater to the owners of the media [1].

EVOLUTION OF MEDIA AND INTERVENTIONS

Media has come to be regarded as the fourth pillar of a democratic nation since it acts as the watchdog which exposes excesses, corruption and also holding accountable; those who were in power. It acts as the platform for a rational debate by acting as primary source of news and information. It is also a representative of the public who, owing to their huge growth, is not able to participate actively or directly in the democratic process [2].

Earlier while media was confined to print and screens now, they have gone digital only to inspire so much of optimism about its strength to ensure access to wider opportunities both economically and politically. However, with this massive growth the challenge is to understand whether the information is too much or too less or half-baked or even fake or true in its sense. There can always be room for misinformation or disinformation or even a propaganda that leads to a social chaos that can disrupt the harmony that is woven into the societal fabric [3].

India, nation with over 1.3 billion citizens, Microsoft had in a 2019 study concluded that over 64% of Indians have engaged with false information in some manner. There are numerous outlets like the traditional prints, television and social media platforms which leaks such false information and it has really been a daunting task to control the same. However, too much of curbing or intervention by the State or the Judiciary could end up the media being gagged arbitrarily. Thus, the approach of curbing any

false information or misinformation or propaganda shall be in such manner that it should respect and protect the fundamental human rights, with freedom of expression and privacy being placed as a priority. The chances for incentivising overboard censorship will take lead in the event that government imposes legislation to restrict their freedom of expression [4]. Similarly, internet shutdowns situations has happened which is also a classic example of arbitrary intervention.

Media and judiciary are complimentary to each other that they both view man as the center of the universe. While the media investigates, unearths and exposes the human achievements and follies, the judiciary deals with the legal issues that man has brought about. The judiciary and the media share a common goal; to seek the truth, defend democratic ideals, ad address social, political and economic issues. In fact, the judiciary has been referred to be the dispenser of justice and the engine for socialreforms, while the media has been described as the watchdog of society and the handmaiden of justice. Consequently, both are necessary for the development of a civic society. Publicity before thetrail is harmful to the integrity of a fair trial.

FREE SPEECH v. FREE TRIAL – ART. 19 (1)(a) v. ART. 19(1)(a)

The rule of law is arguably the most basic requirement of any civilized society, and an independent judiciary, to which access is available to all citizens, is an essential ingredient of the rule of law. Freedom of expression is also fundamental in a democratic society, in which the courts and the media have vital and complementary institutional roles. Together, they hold power to account, enforce the rights of individuals and shed light on matters of public interest - and they also monitor each other [5]. Ironically, the provision under article 19(1) (a) of the Constitution, a guaranteed fundamental right, differs in interpretation and is a challenge for both the judiciary and the media alike.

Media and democracy are so closely related that neither would exist without the other. A robust media plays a critical role as a conscientious

protector and watchdog of the national institutions and seeks to confront inequities in our system by bringing them to light in the hope that they will be addressed, making it a necessary part of a modern democracy. "The special harm of prohibiting the expression of an opinion is that it deprives the human race both the present generation and those who will follow it, as well as those who disagree with it. If the opinion is correct, they are denied the chance to exchange falsehood for truth; if it is incorrect, they forfeit what is gained.

All citizens shall have the right to freedom of speech and expression [6]; "The freedom of the journalist is an ordinary part of the freedom of the subject and to whatever length, the subject in general may go, so also may the journalist, but apart from statute law his privilege is no other and no higher. The range of his assertions, his criticisms or his comments is as wide as, and no wider than that of any other subject" [7]. Freedom of the press is not expressly guaranteed as a fundamental right, it is implicit in the freedom of speech and expression. Freedom of the press has always been a cherished right in all democratic countries and the press has rightly been described as the fourth chamber of democracy [8]. The fundamental principle which was involved in freedom of press is the "people's right to know". It therefore received a generous support from all those who believe in the free flow of the information and participation of the people in the administration; it is the primary duty of all national courts to uphold this freedom and invalidate all laws or administrative actions which interfere with this freedom, are contrary to the constitutional mandate [9].

There has been persistent discord between media and the judiciary which is an inevitable dichotomy and there has been constant tussle between the two Constitutional right of free trial and free speech thereby giving rise to dialogue by way of various international instruments [10].

The Madrid Principles in Media and Judicial Independence which was conducted by the International Commission of Jurists in 1994 provide for

the principles as under [11];

1. Freedom of media is constituted under freedom of expression and the various facets of rights of media include seeking, disseminating and imparting information to the public to facilitate the administration of justice.
2. No restrictions should be imposed which are discriminatory in nature.
3. The basic principles are subject to be restricted in case of any sort of prejudice to the defendant.
4. There should be no restrictions of any special nature applied to the reporting of a matter concerning the administration of justice.
5. Every person shall have a right to communicate information about an on-going investigation.
6. Secrecy of investigation should be maintained to ensure the principle of presumption of innocence of the accused.

MEDIA TRIAL: A THREAT TO DEMOCRACY?

The need for publicity needs to be seen in the context of the enormous and rather unusual role that the courts in India fulfill. The courts in India are not merely adjudicators of private disputes between citizens or between citizens and the State. India is quite unique in the monumental role that the higher judiciary is playing in the democratic system [12]. If the media are silenced and journalists are muzzled, a key pillar of a functioning democracy is crushed. It means that an institution which is vital to a free society, which seeks to ensure accountability, to highlight injustices, to inform the public about matters in their interest, and to serve as a conduit between the people and their representatives, is neutralized. The loss of a free, independent media is essentially the loss of democracy [13].

The media especially the electronic media has profound impact on the public perceptions and sometimes a journalist shallow understanding of the legal system or sensational issue can, not only distort public perceptions, but also erode the confidence of the public in the judicial

system. There is a growing tendency among the media to make comments on the merits of the case pending before the courts, while reporting on pending proceedings. Talk shows are held on the merits on interim orders passed by the courts, conflicting views, even on interim orders, are broadcasts and the anchor, in some cases, finally pronounce the verdict also. Such trail by media has the effect of interfering with the administration of justice and therefore will amount to criminal contempt. The theory of justice is that conclusions to be reached in a case will be induced only by the evidence and not by outside influence, whether of private talk or print media, and argument in open court [14].

In a democratic society public must have access to information. There can be no matter of doubt that but for investigation journalism misdeeds and mischiefs committed in the corridors of power would never see the light of the day. Over a period of time, it is now proved that investigative journalism is a very valuable and inseparable facet of the freedom of press. In a democratic country one of the pillars of the freedom is the freedom of press. It is only and only a responsible press which can claim not only freedom but also immunity from being compelled to divulge the source of its information.

Hence, it will be so risky to permit media to have a wide and sweeping pre-trial publicity of any case, whether criminal or civil, virtually developing a trail by court into a trail by media, especially on the undisclosed sources of information [15].

Sometimes the lines between generating public opinion on a matter of public importance and prejudicing an ongoing court proceeding become blurred. This is because judges, no matter how upright and independent, cannot remain entirely immune from public censure. It is doubtful that there is any quick fix to the challenges posed by media trials. Judicial reprimands and convictions for contempt of court offer no lasting solution and their effect is usually counterproductive. The private television industry in India is still only about two decades old. Self-regulation has only just been

mooted in the last few years and is yet to take shape. It is hoped that mature and responsible reporting will come with time and better self-regulation. The media industry must ensure this in its own interest and in that of the open justice system [16]. Publicity is the surest sanitizer of the system-it was famously described as "the surest of guards against improbity that keeps the judge himself while trying, undertrial" [17].

Today there is a feeling that in view of the extensive use of the television and cable services, the whole pattern of publication of news has changed and several such publications are likely to have a prejudicial impact on the suspects, accused, witnesses and even Judges and in general on the administration of justice. It said that publications which interfered or tend to interfere with the administration of justice would amount to criminal contempt under the Contempt of Courts Act, 1971. It further suggested that if in order to preclude such interference, the provisions of the Contempt of Courts Act were to impose reasonable restrictions on freedom of speech; such restrictions would be valid [18].

Some Governments, even in well-established democracies, have been invoking the COVID-19 pandemic as an excuse to place inappropriate limitations on the public's right to know, and to encourage distrust in the media. The judiciary should be a bulwark against efforts to undermine free media. Defending media freedom can require the judiciary to strike down the rules and actions of the Government which do not properly respect the right to receive and impart information and opinions, and other fundamental rights.

Governments purporting to defend and promote media freedom, including members of the Media Freedom Coalition in the United Kingdom, should work to maintain the independence and integrity of their own judiciaries, and demonstrate respect for the principle of open justice. They should act as a "Coalition of the Committed" that leads through action and by example, while encouraging other states to do the same. The High-Level

Panel of Legal Experts on Media Freedom will continue to provide advice to these Governments and report on their responses to its recommendations.

If the reports in the media are responsible for the creation of a perception in a large number of people in the country that a particular person is guilty or he is innocent, and ultimately when the matter goes to the trial if the result is opposed to the perceptions of people, generally, they tend to believe that the court was not fair [19]. Premature disclosure or leakage to the media in a pending investigation will not only jeopardize and impede further investigation, but many a time, allows the real culprit to escape from the law [20]. The medias are not free to publish any kind of report concerning a sub judice matter or to do a sting on some matter concerning a pending trial in any manner they please. The legal parameter within which a report or comment on a sub judice matter can be made is well defined and any action in breach of the legal bounds would invite consequences [21].

Despite the significance of the print and electronic media in the present day, it is not only desirable but the least that is expected of the persons at the helm of affairs in the field, is to ensure that trail by media does not hamper fair investigation by the investigating agency and more importantly does not prejudice the right of the defense of the accused in any manner whatsoever. It will amount to travesty of justice if either of these cause impediments in the accepted judicious and fair investigation and trial [22]. Presumption of innocence of an accused is a legal presumption and should not be destroyed at the very threshold through the process of media trail and that too when the investigation is pending. In that event it will be opposed to the very basic rule of law and would impinge upon the protection granted to an accused under Article 21 of the Constitution [23]. It is essential for the maintenance of the dignity of the courts and is one of the cardinal principles of the rule of law in a free democratic country that the criticism or even the reporting particularly, in sub judice matters must be subjected to checks and balances so as not to interfere with the administration of the justice [24].

CONCLUSION

A healthy democracy can be attained through two ways; First, it makes sure that people don't act based on misunderstandings or ignorance but rather make wise decisions. In order to make sure that elected officials respect their oaths of office and carry out the views of people who elected them, information performs a "checking function." A healthy and essential component of properly operational democracies in some nations is the adversarial interaction between the media and the government. Such a combative, tense relationship may not be suitable in post- conflict and serving as a mediator between the government and all sides of civil society must still be recognized.

The objective of media development generally should be to shift the media from one that is directed or even overtly controlled by government or private interests to one that is more open and has a degree of editorial independence that serves the public interest. This is especially true in the context of supporting democratic transitions. The ultimate aim of media assistance should be to foster a variety of different platforms and credible voices, as well as to build and strengthen a sector that supports such outlets, if the media is to play any significant part in democracy. Credible source gives people the information they need to engage in society.

As aforementioned, media and judiciary are mutually complimentary in bringing out the truth of a fact. However, on the one hand recent judgment by the Madras High Court with regards to Mangalsutra, and on the other hand giving marital rape clause a blanket effect by the media have been misleading. Hence, there rests a duty on both the judiciary as well as the media to ensure that they refine their citizens or the public in a progressive manner and not misleading them to think otherwise and make erring decisions. This paves way to a better democracy, when there is an opportunity for the public to distinguish between the truth and what is in excess through appropriate inquisitive approach.

REFERENCES

1. Peter Dahlgren, *Media And Political Engagement: Citizens, Communication And Democracy (Communication, Society And Politics)* (1995).
2. Peter Dahlgren, *the Transformation of Democracy* (2001).
3. Andrew M. Guess & Benjamin A. Lyons *Social Media and Democracy: The State of the Field, Prospective For Reforms 10* (Nathaniel Persily & Joshua A. Tucker, Eds., Cambridge University Press 2020).
4. Spandana Singh, *India: A False Infior Mation System (Social Media Impacts On Conflict and Democracy: The Tectonic Shift)* (Taylor & Francis, Eds., Routledge 2021).
5. Lord Neuburger, Ms. Amal Clooney, Baroness Helena Kennedy and Mr. Can Yeginsu, <https://www.unodc.org/dohadeclaration/en/news/2021/05/the-need-for-independent-judges-and-a-free-press-in-a-democracy.html>, last accessed on October 4, 2022).
6. Article 19 (1) (a), Constitution of India , 1950
7. Channing Arnold v. King Emperor, AIR 1914 PC 116, 117
8. Printers (Mysore) Ltd. v. CTO, (1994) 2 SCC 434
9. Printers (Mysore) Ltd v. Asst. Commercial Tax Officer, (1994) 2 SCC 434
10. Neeraj Tiwari, "Fair Trial vis-à-vis Criminal Justice Administration : A Critical Study of Indian Criminal System", *Journal of Law and Conflict Resolution*, Vol. 2(4).
11. *The Madrid Principles on the Relationship Between the Media and Judicial Independence*, Established by a Group Convened by International Commission of Jurists, its Centre for the Independence of Judges and Lawyers, & the Spanish Committee of UNICEF, 1994.
12. MADHAVI GORADIA DIVAN, *FACETS OF MEDIA LAW*, 482, Eastern Book Company (2013).
13. Lord Neuburger, Ms. Amal Clooney, Baroness Helena Kennedy and Mr. Can Yeginsu, <https://www.unodc.org/dohadeclaration/en/news/2021/05/the-need-for-independent-judges-and-a-free->

press-in-a- democracy.html, last accessed on 3rd October 2022.

14. Suo Motu case (Criminal), (2009) 2 KLJ 166.
15. Maria Monica Susairaj v. State of Maharashtra, 2009 Cri LJ 2075 (Bom).
16. MADHAVI GORADIA DIVAN, FACETS OF MEDIA LAW,, 480, Eastern Book Company (2013).
17. Scott v. Scott, 1931 AC 417
18. 200th law commission report
19. Maria Monica Susairaj v. State of Maharashtra, 2009 Cri LJ 2075 (Bom).
20. Rajendran Chingaravelu v. R.K. Mishra, (2010) 1 SCC 457.
21. R.K. Anand v. Delhi High Court, (2009) 8 SCC 106.
22. Manu sharma v. State of (NCT of Delhi) (2010) 6 SCC 1.
23. Anukul Chandra Pradhan v. Union of India, (1996) 6 SCC 354.
24. Manu Sharma v. State (NCT of Delhi) (2010) 6 SCC 1.

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ROLE OF SOCIAL JUSTICE MOVEMENTS IN PROTECTING CONSTITUTIONAL RIGHTS

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Abstract: Constitution guarantees us many rights. In many cases some are not able to get access to these rights because of several social constraints. Those limits created due to the age old social views must be crossed in order to enjoy the rights in the fullest extent. The concept of social justice is a dynamic concept that is different in different society. The government authorities frame policies in such a way to ensure social justice guaranteed by the constitution. The legislative body makes laws for protecting the social and economic justice. Judiciary plays a vital role in uplifting the social justice concept through judicial activism by filling the gaps in law and by giving wider interpretations. The social Justice Movements paves the way towards social justice by ensuring the constitutional guarantees. A proper understanding about how to enforce rights is necessary to study the future potential of civil rights movements. Re-shaping society will be the long term goal that would get approved as a result of these movements.

INTRODUCTION

Even though Indian Constitution borrowed features of almost all constitutions of the world, it is very unique in its content and spirit. The Preamble to the Indian Constitution assures to all its citizens, justice - social, economic and political; Liberty of status and of opportunity, and

promotion among them all; Fraternity assuring the dignity and the unity of the nation [1]. Thus, there are three aspects of justice as provided by the Preamble. They are: social, economic and political and are secured through various provisions of fundamental rights and directive principles. Among them, social justice is the most important as it encompasses the other two in itself as well [2]. Being highly influenced by the concept of social equality and social justice, our constitutional framers have incorporated related provisions in the Constitution. The words, “socialist”, “secular”, “democratic” and “republic” in the Preamble are an example. Full protection of these words is an obligation of administration. In situations where the system fails in delivering this our country has seen rise of several social justice movements fighting for constitutional rights and succeeding in achieving them.

Concept of social justice

Social justice means availability of equal social opportunities for the development of personality to all the people in the society, without any discrimination on the basis of caste, sex or race [3]. Social justice is a dynamic concept that changes with time, circumstances, people’s culture, economic and political standards. This concept is founded on basic ideal of socio-economic equality and its aim is the removal of socio-economic disparities and inequalities [4]. The concept of social justice must be the foundation of every democratic nation.

Social justice can be said to be the foundation stone of Indian Constitution. For a “welfare state”, the concept of social justice is essential. It is a condition precedent for any welfare state. In India, Dr.B.R.Ambedkar is known as the man of millennium for social justice and he advocated a social system based on equalization in society among individuals in all spheres of law. His concept of social justice stood for equality, liberty and fraternity for all human beings. He clearly understood that all are not same in society. So he setup certain rules fighting marginalization and oppression hand to hand.

SOCIAL JUSTICE AND CONSTITUTION OF INDIA

As already pointed out, various components of social justice can be seen various provisions under our Indian Constitution. That is, it can be said that majority provisions of Indian Constitution aim at furthering the aims of social justice either directly or indirectly. From the first page union policy itself, that is from the Preamble, social justice acquires its position and importance. In *Workmen of Meenakshi Mills Ltd. v. Meenakshi Mills Ltd.* [5], the Court held that the Preamble to the Constitution declares the solemn resolve of the people of India to secure all the citizens justice – social, economic and political. After the Preamble, we can say Article 14 is the first source of social justice that provide for the concept of equality. Even though Article 14-18 deals with “right to equality”, because of its wide ambit and applicability, Article 14 is recognized as the equality clause. Articles 15, 16, 17 and 18; Article 21 dealing with “right to life and personal liberty”; “right to education” under Article 21A; Articles 23 and 24 dealing with “right against exploitation”, “cultural and educational rights” under Article 29 and 30; “right to constitutional remedies” under Article 32 and 226 – all these are fundamental rights dealing with the concept of social justice and social welfare. Some Directive Principles of State Policy that embody the principle of social justice and social welfare are – “promotion of social welfare” under Article 38; “distribution of resources as per common good” under Article 39; “equal pay for equal work” under Article 39; “just and humane working conditions” under Article 42; “promotion of educational and economic interests of Scheduled Castes, Scheduled Tribes, and other weaker sections” under Article 46.

WELL KNOWN SOCIAL JUSTICE MOVEMENTS IN INDEPENDENT INDIA

There are so many social justice movements happened in India over the years. Some of such postconstitutional social movements are:-

1. Narmada Bachao Andolan, 1985

This was the most powerful mass movement which involved many human rights activists, environmentalists, native tribes, villagers, farmers, etc. against the construction of dam across the river

Narmada. Medha Patkar and Baba Amte were the leaders of the movement. As per the proposed project on dam construction, more than 2,50,000 people were to be displaced from their places and the said movement was over the rehabilitation or resettlement of these people. The mode of campaign under the movement included rallies, hunger strikes, court actions, etc. The Supreme Court upheld the decision of government to go ahead with construction only after ensuring proper rehabilitation to the displaced people. The movement marked how big projects result in large scale displacement of local communities. The concern and questions raised by the movement still echo in India.

2. Nirbhaya Movement, 2012

In December 2012, a 23-year old female medical student was violently gangraped in a moving bus in New Delhi and was later dumped on highway in brutally injured and unconscious form. She didn't survive the attack but the media named her "Nirbhaya" and the torture she faced and her death sparked a revolution in India. This opened up a space for victims to speak out against sexual violence they faced. After the 2012 Nirbhaya outrage in Delhi, upon the recommendations of Verma Committee, Criminal Law (Amendment) Act, 2013 was passed and that made changes in the Indian Penal Code, Code of Criminal Procedure, Indian Evidence Act and Protection of Children from Sexual Offences Act. In 2018, further changes also introduced in punishments. Right to life provided by the constitution seemed to be insufficient in protecting women. The shame created was discussed globally. It helped in creating heated debates on women's justice.

3. Me too Movement

This movement gained popularity in recent years but it was originally started in 2006 by Tarana Burke. In 2014, there was "Yes All Women" that motivated women to go public with their experience with misogyny. Because of this movement, many personal stories buried under years of silence emerged out to public media. This campaign

helped victims to find courage to name the accused publicly. This is a movement against sexual abuse or harassment committed by powerful and popular men in the society. Me too allegations range from inappropriate or disrespectful behaviours to rape. This movement can be said to be one of the important events in the struggle for women empowerment. The me too movement broke certain idols and gave more women the courage to open up and speak. It was a great jump in the progress of women's justice.

4. Farmers Protest

In 2020, Indian government passed three Acts with the intention of bringing reforms in the field of agriculture. These three Acts are - The Farmers' Produce Trade and Commerce (Promotion and Facilitation) Bills, 2020; The Farmers (Empowerment and Protection) Agreement of Price assurance and Farm Services Bill, 2020; and The Essential Commodities (Amendment) Bill, 2020. But, the farmers group has not received them well. Various stakeholders, traders, farmers and state governments opposed the three Acts on various grounds like these three farm laws did not include the safety net of MSP, etc. Fear of dominance of big corporates was also a matter of concern in this regard. Farmers from every part of the country organized into groups and led the protest. Later the laws were withdrawn. Farmers are the basic producers in a country. The selfish moves to forget the slogan 'Jai Jawan Jai Kisan' was fought out by the people's uprising.

SOCIAL JUSTICE AND JUDICIAL PRONOUNCEMENTS

In India, judiciary has played a great role to make the concept of social justice successful. Speedy justice is a component of social justice and right to speedy trial was made a fundamental right under Article 21 of the Constitution through the judicial pronouncement in *Hussainara Khatoon v. State of Bihar* [6]. In *S.P. Gupta v. Union of India* [7], while discussing the independence of judiciary, it also explained the role of judiciary in realizing the constitutional goal of social justice. In the case, Court held that social justice and judicial review is the basic feature of the

Constitution of India. In *D.S. Nakara v. Union of India* [8], the Supreme Court held that the principle aim of a socialist state is to eliminate inequality in income, status and standard of life.

In *Indra Shahani v. Union of India* [9] the Supreme Court held that 27 % reservations are legal for socially and economically backward classes of the society under central services. In *M.R. Balaji v. State of Mysore* [10], Supreme Court held that for the object of compensatory justice, reservation limit should not be more than 50%. *Indira Sawhney v. Union of India* [11] also approved this balance between distributive justice through quality and compensatory justice. Here, social justice can be seen as a dynamic device to mitigate the sufferings of the poor, weak, dalits, tribals and deprived sections of the society.

In *Sadhuram Bansal v. Pulin Behari* [12], it was observed that social justice is one of the aspirations of the Indian Constitution.

In another case, *PUDR v. Union of India* [13], it was held that minimum wages must be given and not to pay minimum wages is violation of human dignity.

Social justice is the comprehensive form to remove social imbalance by law harmonizing the rival claims of interest of different groups or section in the social structure or individuals by means of which alone it would be possible to build up a welfare state [14].

In *Air India Statutory Corp. v United Labor Union* [15], it was held that Preamble and Art.38 of the Constitution envision social justice as the arch to ensure life to be meaningful and liveable with human dignity.

If we search for judicial pronouncements, we get plenty of it related to social justice. Landmark judgments in 2000s like Puttaswami case, Navtej Singh Johar case are some of the other examples.

SCHEMES PROMOTING SOCIAL JUSTICE IN INDIA

Beti Bachao, Beti Padhao, Women Helpline, UJJAWALA, NARI SHAKTI PURASKAR, Mahila Shakti Kendras, NIRBHAYA, Pradhan Mantri Shram Yogi Maan-Dhan Yojana (PM-SYM) – for old age protection, National Pension Scheme for Traders and the Self-employed Persons (NPS), Pradhan Mantri Jeevan Jyoti Yojana (PMJJBY), Pradhan Mantri Suraksha Bima Yojana

(PMSBY), Atal Pension Yojana Pradhan Mantri Awaas Yojana-Gramin (PMAY-G), National Social Assistance Programme (NSAP) – for old age protection, Bharat- Pradhan Mantri Jan Atrogya Yojana (AB-PMJAY), Health Insurance Scheme for Weavers (HIS), Pradhan Mantri Kisan Mandhan Yojana, Self Employment Scheme for Rehabilitation of Manual Scavengers, DeenDayal Disabled Rehabilitation Scheme (DDRS), Adal Vayo Abhyuday Yojana (AVAY), the government subsidy schemes for the promotion of scheduled caste and scheduled tribe communities, etc. are some of the social justice related schemes. Over the years these schemes have uplifted certain oppressed people from their position. Even though corruption and red tapism are dragging the progress behind, many rules have come up as result of people fighting for justice and societal equity.

CONCLUSION

Social justice is very relevant in governance and public policies. It is an essential element that the government should take into consideration during the framing and execution of public policies, laws, rules and regulations. Many governments across the world have a concern over department of social justice and in India we have the Ministry of Social Justice and Empowerment of India which is entrusted with social justice and welfare of marginalized communities. Democracy is a system established for the people, by the people. If a democratic regime does not fully succeed in protecting the constitutional rights people have to step up and raise their voice. If we look at the successful social movements in our country we can see an organic nature. These movements were not hatched out of some selfish political gain. No one was able to buy it for a sum of money. Such movements bring out the true essence of our constitution and protect the marginalized.

REFERENCES

1. Preamble, Constitution of India.
2. Subhash Shukla, Social Justice in India: Constitutional Vision and thereafter, 75 IJPS p. 315, pp. 315-326 (2014), [https://www.jstor.org/stable.24701139](https://www.jstor.org/stable/24701139).

3. S. Wasim Ahmad & M. Ashraf Ali, Social Justice and the Constitution of India, 67 IJPS p. 767, pp. 767-782 (2006), <https://jstor.org/stable/41856262>.
4. Aikyer K.J., Judicial Dictionary (2001) p.909.
5. [1992] 3 SCR 33.
6. Hussainara Khatoon v. State of Bihar, 1979 SCR (3) 532.
7. S.P. Gupta v. Union of India, AIR 1982 SC 149.
8. D.S. Nakara v. Union of India, 1983 AIR 130.
9. Indira Shahani v. Union of India, AIR 1993 SC 497.
10. M.R. Balaji v. State of Mysore, AIR 1963 SC 649.
11. Indira Sawhney v. Union of India, AIR 1993 SC 477.
12. Sadhuram Bansal v. Pulin Behari, 1984 AIR 1471.
13. PUDR v. Union of India, AIR 1982 SC 1473.
14. Dalmia Cement Ltd. Union of India, (1996) 10 SCC 104.
15. Air India Statutory Corp. v. United Labor Union, AIR 1997 SC 654.

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DETECTION OF COLON CANCER BY APPLYING MACHINE LEARNING AND IMAGE PROCESSING

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Abstract: Colon cancer begins when healthy cells in the lining of the colon change and grow out of control, forming a mass called a tumour. Then the affected area is analysed using Colonoscopy, CT-Scans etc. There is higher chance of recovery if detected early. For accurate diagnosis, the biopsy and colonoscopy data are collected, and careful examination is needed to be done. Use of machine learning techniques can be useful in quick detection of cancer by applying image processing and machine learning techniques. It involves many steps like pre-processing, segmentation, extraction and classification and decides the situation. It makes the overall task much easier and fast.

1. INTRODUCTION

Cells are the basic building blocks of all living things as they provide structure for the body, absorb nutrients from food, convert those nutrients into energy, and carry out specialized functions for the body.

The body forms new cells by dividing when required by replacing old cells that die. Sometimes this process goes wrong and new cells grow uncontrollably. This results in tumour. Tumours are groups of abnormal cells that form lumps or growths. It can behave differently depending on the type, such as Benign or Malignant. Benign aren't cancerous, while malignant are cancerous. Benign tumours stay in the primary location without affecting others. Most benign tumours do not cause many issues,

except if they occur in the main parts of the human body, such as blood vessels or nerves. Mostly benign tumours caused due to the exposure to the environment toxins, radiations, genetics etc. In many cases, benign tumours need no treatment. The doctors consider a waiting period to make sure it doesn't cause much damage in future. Surgery is the primary treatment for this case, depending on where it occurs. Other types of treatment may include medication or radiation, depending on the situation.

Malignant tumours are cancerous. The malignant tumours do not stick to that originated position like benign one. As the time passes, it will develop, and it will start to affect neighbouring healthy cells and in later stages it will start to affect other parts of the body which seriously affects the person. Mostly, this type of cancers is diagnosed early due to symptoms and there can be situation of no symptoms which are not common, but severe. In this case, the person will only get symptoms at the last stage, which results, the tumour spread to other parts of the body, eventually less chance of survival of that patient.

Colon cancer occurs in the inner wall of the colon. It is formed as polyps, and removal of these polyps is the solution. It is diagnosed by colonoscopy, CT-Scans etc. Treatment depends on the size, location and extent of the tumour spread.

1.1. Colon

Colon is an organ that is part of the digestive system that is located in the large intestine (Figure 1). It handles the leftovers of the small intestine and processes them. It absorbs water and bacteria present in the colon and breaks down the remaining particles and moves the leftover to the rectum. The parts of the rectum:

- Caecum: It's the beginning of the colon.
- Ascending colon (right colon): It is the first part of the colon.
- Transverse colon: It is the middle part of the colon.
- Descending colon (left colon): It is the third part of the colon.
- Sigmoid colon: This is the last part of the colon.
- Rectum: The stool goes through the rectum and the rectum ends at the anus.
- Anus: It is the opening at the end of the colon.

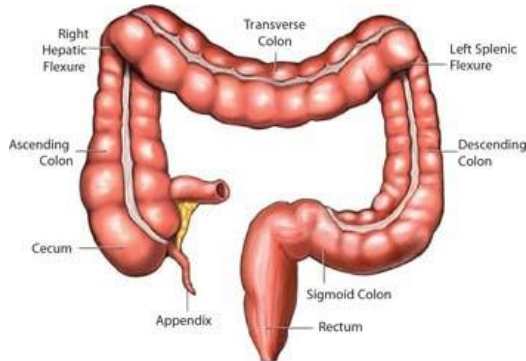


Figure 1 Anatomy of Colon

There are different types of Colon cancer:

- Adenocarcinoma: It is the most common type which is formed on the inside lining of colon.
- Carcinoid Tumours: This is a slow forming tumours which formed on the hormone-producing cells, and it is a cancerous one.
- Gastrointestinal Stromal Tumours: It is formed on the special nerve cells in the walls of the large intestine.
- Lymphoma: Lymphoma is a type of cancer that affects the immune system, mainly lymph nodes, but can start in the colon.
- Hereditary Colon Cancer: This type of cancer is genetically caused, i.e., it is family shared from parents to children.

2. Diagnosis of Colon Tumour

The diagnosis of Colon tumour is done using medical test such as CT Colonography and colonoscopy. CT Colonography is widely used because of less risk and other clinical factors. Computed tomography (CT) is a diagnostic medical test produces multiple images of the inside of the body. CT Colonography uses low dose radiation to scan to obtain an interior view of the colon (the large intestine) instead of a more invasive procedure like endoscopy, in which a tube along with a camera at the tip is passed through the anal opening to get the interior view of the large intestine. The CT Colonography can easily find polyps without many problems and if found, then Colonoscopy is done to remove polyps which will be then taken for further study.

2.1. Main Issues

At present the detection of abnormality via CT often occurs using manual inspection of every image slice which may be in thousands. This is a very time consuming complex process and prone to manual error. CT Colonography images contain noise during image capturing and segmenting colon from noise is the key task. Hence, there is need of advanced automated tool to segment colon, detect polyps, assess its risk, and look for cancerous growth using CT Colonography images by using the advanced technologies such as deep learning algorithms and reduce inspection time, without sacrificing detection sensitivity and specificity.

3. Objective

The main objective is to analyse polyps and classify them, whether the tumour is benign or malignant. Initially, the colon datasets are collected and given as input to the system. Then data preprocessing is applied on the input images, for enhancing the image to get the high contrast images and removal of noises. Then it undergoes segmentation, feature extraction followed by classification of the tumour. The dataset can be collected from the 'The Cancer Imaging Archive' (TCIA).

4. Methodology

To analyse the tumour, we use CT-Scan report. But CT scan reports may contain noise which cannot be seen by the human eye. Due to this reason, various digital image processing methods are applied to get a noise free image. Digital image processing is the process of analysis and manipulation of an image, which is used to extract some useful information from the image. Digital image processing involves various steps like image pre-processing, in which we can enhance the image using histogram equalization and median filter. After that, it undergoes segmentation. Image segmentation is a process which divides the image into several segments. Once the image segmentation is over, the feature extraction follows.

Feature extraction mainly focused on extracting the features such as region and texture based information. After extracting the features, a different machine learning technique is used to classify the image (Figure 2).

The proposed method composed of four layers:

- Pre-processing layer

- Segmentation Layer
- Feature Extraction
- Classification Layer

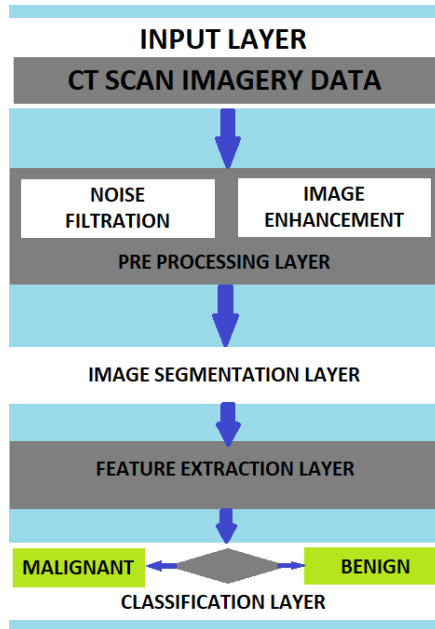


Figure 2 Proposed Framework for cancer prediction

4.1. Pre-Processing Layer

Pre-processing layer focus on enhancing the image and removal of noise from the data and making it suitable for a machine learning model. It increases the accuracy and efficiency of the model.

Pre-processing involves two tasks:

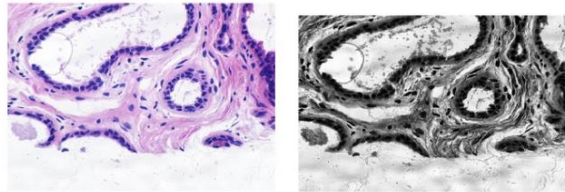
- 1) Image Enhancement
- 2) Noise handling

4.1.1. Image Enhancement

This involves increasing contrast of the image. In this, CT-Scan image is passed through Contrast Limited Adaptive Histogram Equalization (CLAHE) is used instead of histogram equalization. Histogram Equalization enhances the image by spreading the pixel histogram values. The problem with the

histogram equalization is that enhancement is not confined to a particular location, and also noise can get enhanced. Histogram equalization can result into too dark or too bright regions, as the contrast is not limited.

Due to these reasons, Contrast Limited Adaptive Histogram Equalization is used as it divides images into small blocks(8 x 8 tiles) and each block is equally enhanced. To minimize noise amplification, contrast limiting is applied. Example Figure 3.



Before

After CLAHE

Figure 3 CLAHE on Histopathological image

4.1.2. Noise handling

Here we can use Median filter to remove noise and smoothing of the images. The process is worked by replacing each value with the median value of the neighbouring pixels. In this, a pattern is formed by the neighbours, which is called the 'window slide'. In this, it will sort all the pixel values to numerical from the window slide, and then it replaces the median/middle pixel value with the pixel. It can smooth the value of the pixel without affecting the other surrounding pixels.

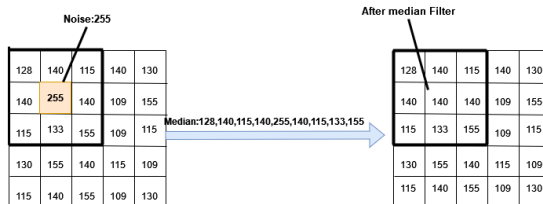


Figure 4 Median Filter

4.2. Segmentation Layer

This layer involves the process of divide or partition of an image into multiple segments. The goal of image segmentation is to change the image

representation to more meaningful and something easier to analyse, which is typically used to identify the boundaries and the objects of the image. For image segmentation, first we have applied edge detection technique which can segment the boundary of the image, for that Prewitt operator can be used in which threshold a has been applied so that after edge detection, the intensity value which is less than threshold is removed and the intensity value which is higher than or equal to threshold will be considered for further segmentation. After getting the segmented image by edge detection, watershed segmentation on the output image using gradient can be used. The gradient magnitude is used to pre-process the gray scale image. It has high pixel value along the object edge and low pixel value in another left region and through this we can get the final segmented image through which we can extract features.

4.3. Feature Extraction

Feature extraction is mainly for to extract essential features for further processing. In feature extraction, the result of the segmentation process is then used to extract two types of information, region based and texture based information. In region based, features like area in context to image, which is called pixel of the image, perimeter in context to image, meaning the vector containing the distance around the boundary of each region of the image, the centre of mass of the region, called the centroid, and it is in 1×2 vector form. On the basis of texture, features like mean, which is used to find the average intensity, standard deviation measuring the average contrast, smoothness, which is used for measuring the relative smoothness of the intensity in the region and entropy, measuring the randomness using statistical approaches were extracted.

4.3.1. Region Based Extraction

A pixel is taken as a seed pixel. Then it is used to determine the similar neighbourhood pixel. In comparison with the initial seed, if the pixel is found to have the similar criteria, then it is added to the region. The pixel is added based on the similarity index. This process continuous until no more pixel can be added to the region. The new pixel value is added to the region only if the difference between the region and the new pixel is lesser than the threshold value. On the other hand, if its value is greater than the threshold value, then the region's growing process is finished. The Segmentation process mainly works on removing the dark area that does not belong to the colon. Using this approach, a minimum pixel value is

selected from the boundary of the image, which may be a dark pixel. The pixels following the 4-neighbourhood connectivity criteria are added to the region. Using the Region based algorithm, all the black pixels in the respective region are deleted.

4.3.2. Texture Based Extraction

The Texture based features are obtained from the Gray Level Co-occurrence Matrix (GLCM). Gray Level Co-occurrence Matrix is the matrix that contains all the relative frequencies $p(a,b)$ with intensity value a , which occurs in spatial relationship with value b . The total sum of the pixel values in GLCM is 1. Texture features such as entropy, energy, contrast, correlation and homogeneity are considered.

- Energy: The energy is calculated from the sum of the square of all the elements in GLCM and its value lies between 0 and 1 and If the image is constant, then it has a value of one. It provides the uniformity of the pixels.

$$\text{Energy} = \sum_{a=1}^X \sum_{b=1}^Y P^2(a, b) \quad (1)$$

- Entropy: It is a statistical measure which describes the randomness of an image. If the calculated value of the entropy is low, then there is low pixel contrast variation and a high value indicates that there is a great difference between two pixel values.

$$\text{Entropy} = - (p \cdot \log_2(p)). \quad (2)$$

- Contrast: It provides the local variations in the GLCM. It determines the intensity difference between a pixel and its neighbourhood. For a constant image, the value of contrast will be zero.

$$\text{Contrast} = \sum_{a,b=0}^{M-1} P_{a,b} (a - b)^2 \quad (3)$$

- Mean: It calculates the mean of all the values in ROI of image.

$$\text{Mean}, \mu = \sum_{a,b=1}^{X,Y} \frac{p(a, b)}{XY} \quad (4)$$

- Standard Deviation: It calculates the average distance between pixel values and the mean. Low value of standard deviation

indicates that there is less deviation of the pixels from the mean, where the large value indicates the high variation.

- Skewness: It gives the asymmetric value of the probability distribution about its mean. The skewness of an image can be positive or negative.

$$\text{Skewness} = \frac{\sum_{i=1}^N (X_i - \bar{X})^3}{(N-1)s^3} \quad (5)$$

4.4. Classification

After the necessary features are extracted, the classification is done by using machine learning techniques. Many machine learning algorithms are available such as support vector machines, artificial neural network etc. After applying the classification algorithms, the results are used to predict the tumour is benign or malignant.

4.4.1. Support Vector Machine

In SVM, the dataset is divided into two classes by using kernel functions. As the images are arranged in a non-linear manner, it will plot the image in 3-D plane by using kernel functions like polynomial kernel, Gaussian kernel, radial basis function, etc and separate the class using a hyperplane (Figure 5). For example, if we take CT scan images of colon, the image will be first pre-processed and then the pre-processed image is trained by using a kernel function and while training, the images are labelled as 1 and 2 for normal and cancerous tumour. After training and testing, the confusion matrix will show the prediction in two form classifications and based on the classification table we can generate accuracy of our prediction.

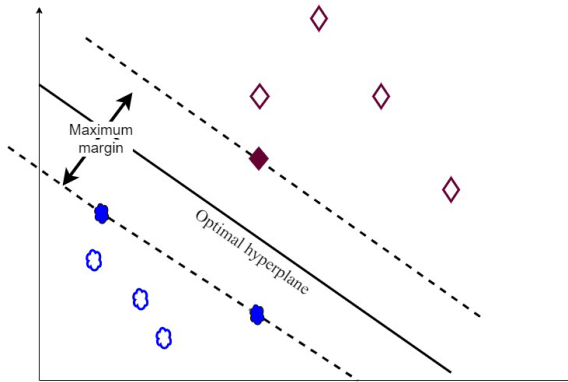


Figure 5 Support Vector Machine

4.4.2. Artificial Neural Network

The Artificial Neural Network (ANN) is a deep learning model. A Multilayer feed forward neural network consists of input layer, hidden layer and output layer. The image is first inserted into input layer, then passed through the hidden layer and is then forwarded to output layer to calculate the activation function and aggregated to get $O(x)$, the difference between $O(x)$ and desire output i.e, error is calculated using back propagation algorithm. Then back propagation is done to minimize the error.

1. Input X, arrive through the pre-connected path.
2. Input is modelled using real weights W. The weights are randomly selected.
3. Calculate the output for every neuron from the input layer then to the hidden layers then to the output layer.
4. Calculate the error in the output layer.
Error = Actual Output – Desired Output
5. Then back propagate from the output layer to the hidden layer to adjust the weights such that the error is decreased (Figure 6).

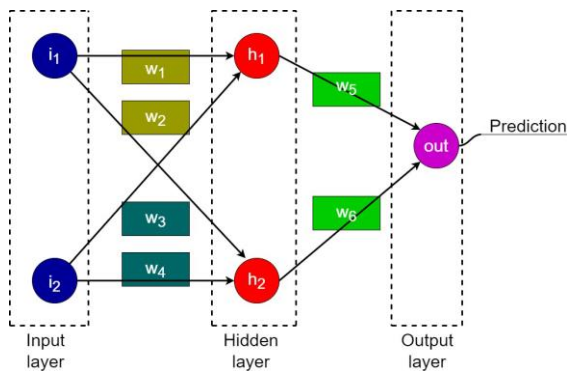


Figure 6 Multi-layer Back Propagation Neural Network

4.5. Performance Evaluation

Model evaluation metrics are used to evaluate the performance of the model. The choice of metrics depends on the machine learning task. Types of model evaluation parameter are:

- Confusion Matrix: Confusion matrix gives a detail description of classification or misclassification in a form of matrix. It consists of true positive (correctly predict the positive class), true negative (correctly predict the negative class), false positive (incorrectly predict the positive class), false negative (incorrectly predict the negative class).
- Classification Accuracy: It measures the performance of our prediction. It can be measured by correct prediction by overall prediction made.
$$\text{Accuracy} = \frac{\text{TN} + \text{TP}}{\text{TN} + \text{FN} + \text{TM} + \text{FM}}$$
- Recall: It measures the proportion of actual positive that are correctly identified.
$$\text{Recall} = \frac{\text{TP}}{\text{TP} + \text{FN}}$$
- Precision: It measures the proposition of positive identification is actually correct.
$$\text{Precision} = \frac{\text{TP}}{\text{TP} + \text{FP}}$$
- F1 score: F1 score is the average of precision and recall.
$$\text{F1} = 2 \left(\frac{\text{Recall} * \text{Precision}}{\text{Recall} + \text{Precision}} \right)$$

5. CONCLUSION

The proposed model shows the overview of prediction of colon cancer at an early stage. The overall process uses ct-scan images. CT Colonography image contains noise during image capturing and segmenting colon from noise was the key issue. By using appropriate techniques, noise were removed, and necessary operations are performed and were able to classify whether the tumour is benign or malignant.

6. REFERENCES

1. Alteri, R., J. Kramer, and S. Simpson. "Colorectal Cancer Facts and Figures 2014- 2016."Atlanta: American Cancer Society (2014): 1-30.
2. Large Intestine Diagram-IvyRoseHolistic <https://http://www.ivyroses.com/HumanBody/Digestion/Large-Intestine-diagram.php>.
3. Haggar, Fatima A., and Robin P. Boushey. "Colorectal cancer epidemiology: incidence, mortality, survival, and risk factors."Clinics in colon and rectal surgery 22.04(2009): 191-197.

4. Polyps of the Colon and Rectum <http://www.msmanuals.com/professional/gastrointestinaldisorders/tumors-of-the-gi-tract/polyps-of-the-colon-and-rectum>.
5. Patient education: Colon polyps (Beyond the Basics) <https://www.uptodate.com/contents/colon-polyps-beyond-The-basics>.
6. Pietikainen, Matti, et al. Local binary patterns for still images. Springer London, 2011.
7. "Histogram of Oriented Gradients (HOG) Descriptor" Intel: <https://software.intel.com/en-us/node/529070>.
8. CT Device: <https://info.blockimaging.com/whats-the-best-ct-scanner-for-you>.
9. Chen, Sloane C., et al. "CT colonography: value of scanning in both the supine and prone positions." AJR. American journal of roentgenology 172.3 (1999): 595-599.
10. CT Colonography: https://www.radiologyinfo.org/en/info.cfm?pg=ct_colon
CT Device: <https://info.blockimaging.com/whats-the-best-ct-scanner-for-you>

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