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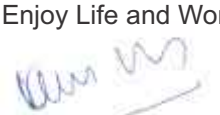
MESSAGE FROM THE MANAGING DIRECTOR

Business today does not need Managers who have learnt the right answer. Need is rather for Managers who are always learning from their jobs, from associates, from courses and from books and who are ever questing the past, evaluating the present and preparing for the future.

We at Catalysts take pride in continuously challenging and reinventing oneself in pursuit of excellence. Success is a pursuit that cannot be achieved by individuals but by the entire team together. Believe in self and believe in each other!

I believe if one is in a happy mind space, then it works as a catalyst to greater performance. Our endeavor is to create a work environment that enables happiness and learning. As long as we are able to steadily work towards this objective, success will be ours!

Enjoy Life and Work Hard!!



Munish Madan

MESSAGE FROM THE DIRECTOR

Dear Friends

The pressure of performance and quality on biotech companies is like never before and the skillful handling of these very pressure makes the Catalysts Group stand out in a crowd.

Excellence, ethics & values continue to be our guiding principle in this new financial year too. We take care to inculcate these values among our team members while shaping and sharpening their mindsets through regular trainings both in-house & through external trainers. Team members in Catalysts are always encouraged to develop an entrepreneurial spirit in their personality and approach so that they spot opportunities, mobilize resources and develop innovative solutions to the critical industry problems of today and are able to foresee.

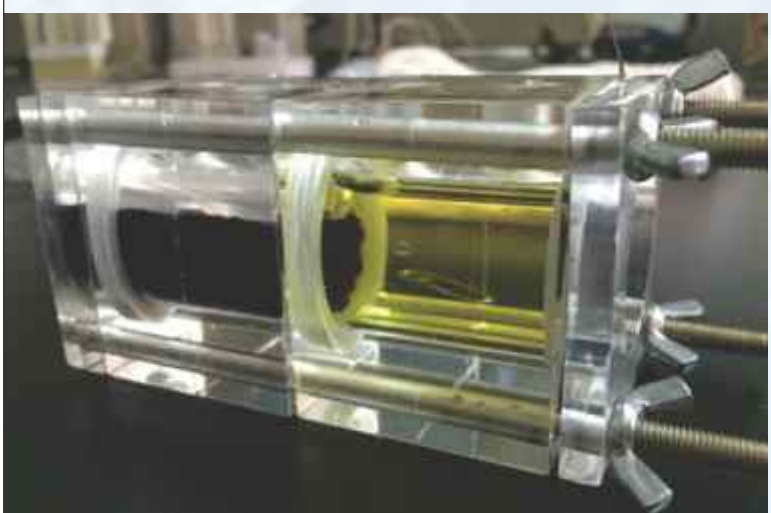
Catalysts Group had a successful Quarter 1 of 2016-17 and the team is all set to offer innovative biotech solutions to the industry over the next three quarters. As the time unfolds Catalysts team will be proud to share with you all about the new products and developments. We thank you for all the support and your guidance which is priceless.

We cannot spell sUccess without U..

Aditya Malhotra

Microbial Fuel Cell: A New Energy Recovery Technology for Distillery Wastewater

Dr. B Chandrashekhar, R&D Department



A laboratory scale rectangular two-chamber microbial fuel cell

INTRODUCTION

Distillery spent wash is the unwanted residual liquid waste generated during alcohol production and water pollution caused by it is one of the most critical environmental issue. Spent wash has very high BOD, COD and other organic-inorganic substances such as chlorides, sulphates, phosphates, sodium, potassium, calcium, melanoidines, caramel, polyphenols and different xenobiotic compounds, which are not effectively decomposed during fermentation and distillation. High COD, total nitrogen and phosphate content of spent wash can result in eutrophication of natural water bodies. Despite standards that have been imposed on effluent quality, untreated or partially treated effluent very often finds access to watercourses from distillery units. The distillery wastewater with its characteristic unpleasant odor and complex chemical composition, poses a serious threat to the water quality in several regions around the world.

Organic material in wastewater can be a source of energy when treated anaerobically. These processes rely on the conversion of carbohydrates and other organic compounds present in the wastewater into simpler compounds and byproducts by the action of enzymes produces by microorganisms. There are a lot of nutrients available in the distillery wastewater.

Microorganisms, especially bacteria can harvest the electrons from the organic matter and transfer it to a terminal electron acceptor which results in the breakdown of organic matter and energy conservation. This breakdown can effectively be controlled by managing the microbial population in the bio-reactors or digesters, encouraging microorganisms to digest the organic matter.
As the spent wash generated in the distilleries have high potential to produce methane, it is subjected to anaerobic digestion for methane recovery, also known as biomethanation. It is a proven technology and now well engrained in distilleries. Although it is an effective technology to mitigate the problem, the conventional anaerobic digestion technologies such as UASB and CSTR have limitations in their ability to provide quality, reliability, and efficiency. Though the process brings down the BOD load from 50,000mg/l (in raw spent wash) to 5000-8000 mg/l, due to their high organic load and salts, further treatment of the spent wash is still required for safe disposal or recycle. Also, the biogas generated often contains less than 50 % methane along with high concentration of hydrogen sulphide along with CO_2. This makes biogas unfit to be used as a fuel

directly and requires enrichment by scrubbing, which further generates a lot of wastewater. The ever-increasing generation of distillery wastewater and stringent legislative regulations of its disposal in the surroundings has stimulated the need for developing alternative technologies to process this effluent more efficiently, along with minimum water discharge and energy recovery.

MICROBIAL FUEL CELL

Generation of electricity from the spent wash employing **M**icrobial **F**uel **C**ell (MFC) technology is one of the futuristic technologies. A microbial fuel cell is a bio-electrochemical device that harnesses the power of respiring microorganisms to convert organic substrates directly into electrical energy, transforming chemical energy into electricity using biological oxidation-reduction reactions. Electrons produced by the bacteria from these substrates are transferred to the anode (negative terminal) and flow to the cathode (positive terminal) linked by a conductive material containing a resistor or operated under a load producing electricity. The device must be capable of having the substrate oxidized at the anode replenished, either continuously or intermittently. Electrons can be transferred to the anode by electron mediators or shuttles or by direct membrane associated electron transfer.

MICROORGANISMS FOR MFC

Some types of soil bacteria can help generate electricity. These bacteria, known as electrogenic bacteria, include the Shewanella species, which can be found in almost any soil on Earth, and the Geobacter species, which prefer living in soil deep underground or even under the ocean, where no oxygen is present. Due to unique metabolic properties of microorganisms, variety of microbes are used in MFCs either as pure culture (e.g. Bacillus subtilis, Enterobacter cloacae) or mixed consortia (Nimje et al, 2009; 2013). However, it is reported that MFCs operated using mixed cultures currently achieve substantially greater power densities than those with pure cultures (Rabaey et al, 2004; 2005). While some iron-reducing bacteria, such as Shewanella putrefacians and Geobacter metallireducens, can be used to make electricity, there are many other bacteria already present in wastewater that can do this. Depending on the wastewater type and other conditions, many new types of bacteria may be discovered that are capable of anodophilic electron transfer (electron transfer to an anode).

DESIGN AND EFFICIENCY OF MFC

There are numerous designs available for a microbial fuel cell, developed and tested at the laboratory scale by various researchers. A widely used and inexpensive design is a two chamber MFC built in an H- shape vessel, consisting usually of two chambers connected by a tube containing a separator which is usually a proton or Cation Exchange Membrane (CEM) or a plain salt bridge. (Figure 1).

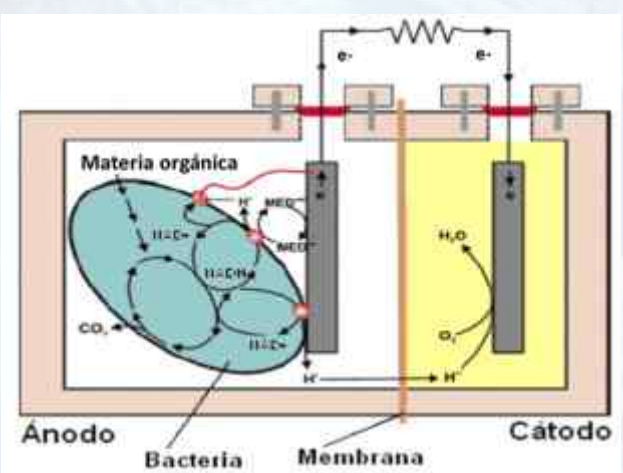


Figure 1 A typical microbial fuel cell and operating principle (Logan et al, 2006)

The design depends on the type of membrane that allows protons to pass between the chambers but optimally not the substrate or electron acceptor in

the cathode chamber (typically oxygen). The salt bridge MFC, however, produces little power due the high internal resistance observed. Therefore, H-shape systems are acceptable for basic parameter research in batch experiments, such as estimating power production using new materials, wastewater or microorganisms, but this design is not suitable for building large scale MFCs.

Several variations on MFC design have emerged in an effort to increase power density and to provide for continuous flow through the anode chamber, so that it can be used for large scale treatment of wastewater. Some examples include MFC with an outer cylindrical reactor (anode) with a concentric inner tube that is the cathode (Liu et al, 2004), with an inner cylindrical reactor (anode) with the cathode on the outside (Rabaey et al, 2005) or like an upflow fixed-bed biofilm reactor, with the fluid flowing continuously through porous anodes toward a membrane separating the anode from the cathode chamber (He et al, 2005). In some designs, the CEM is sandwiched between rectangular anode and cathode chambers, and to increase the overall system voltage several such MFCs can be stacked in series.

The potential for electricity generation using 7500 kg/d of organic food waste containing effluent is 900-1000 kW of power, or 330-400 kW assuming 30% efficiency (Logan et al 2006). At a power density of 1 kW/m^2 a fuel cell of 350 m^3 would be needed. Using distillery spent wash, a maximum current density of 84 mA/m^2 and maximum power density of 29 mW/m2 at an external resistance of 820 ohms has been reported (Nimje et al 2013). In another research, average current of 0.3 mA and power density of 18.35 mW/m^2 has been reported using 6100 mg/L COD in the feed, with about 60-65% COD and BOD removal and 45% DS removal (Anupama et al, 2013). Using sewage sludge, single chamber MFC and Escherichia coli as the degrading bacteria, a maximum power density of 150 to 6000 mW/m^2 has been reported using graphite with neutral red and Platinum and polyanilineco-modified anodes (Nevin et al, 2008; Franks and Nevin, 2010). The power density can be increased by 1.5 to 2 times using ferricyanide instead of oxygen as the electron acceptor in the cathode chamber due to the availability of electron acceptor at high concentrations.

APPLICATION OF MFC IN DISTILLERIES AND SCOPE FOR RESEARCH

The raw distillery spent wash and biodigester effluent can be good candidates for microbial fuel cell because their wastewater is rich in organic compounds that can serve as food for the microorganisms. The wastewater composition is always the same which allow bacteria to adapt and become more efficient. However, the success of specific MFC applications in distillery wastewater treatment will depend on the concentration and biodegradability of the organic matter in the wastewater, dissolved oxygen content, the wastewater temperature and the absence of toxic chemicals. It is suggested that MFC technology may be tried for both pre and post-methanated spent wash to determine whether distilleries would benefit from it. However, most of the research on microbial fuel cells for wastewater treatment till date has been carried out at laboratory scale and hence MFC designs need more improvements and innovations before a marketable product will be possible. The currently available designs cannot be scaled to the level necessary for treatment of hundreds of cubic meters of reactor volume. Large scale application of an MFC can be possible only by increasing the intrinsic conversion rate of MFCs, and simplifying the design so that a cost-effective, large-scale system can be developed. Most preferred design would be that of MFC in stacks to produce increased voltages, since the voltage generated by a

single cell is low.

One of the first steps could also be the development of pilot and large scale reactors at distillery industrial locations where a high quality and reliable wastewater stream is available. This will help engineers and scientists to get information about the troubles which might be faced while treating large volume of distillery wastewater using MFC. Fosters, an Australian beer company, has already tested out an MFC to clean its wastewater while generating electricity and clean water. Fosters has installed a small-scale microbial fuel cell for brewery wastewater treatment (Coats and Wrighton, 2009). Twelve MFCs are placed in parallel to clean the large volume of wastewater. Wastewater flows in at the top, is cleaned by bacteria, and comes out the bottom as purified water. Fosters plans to improve the MFC's treatment efficiency and electrical output, and eventually build a 660 gallon, 2 kW MFC for treating all of the brewery's wastewater. The electricity generated from cleaning the brewery wastewater is expected to pay for the initial cost of the Microbial Fuel Cell in 10 years.

In the future, MFCs will be able to help reduce those costs by producing electricity on site to power the plant's operating equipment. While full-scale and highly MFCs are not yet developed, the technology holds considerable promise for their application in treatment of distillery spent wash. The major hurdles associated with them will hopefully be overcome by high-end research by scientists and new designs by engineers. The growing pressure on our environment and the call for renewable energy sources will further stimulate successful development and implementation of these technologies.

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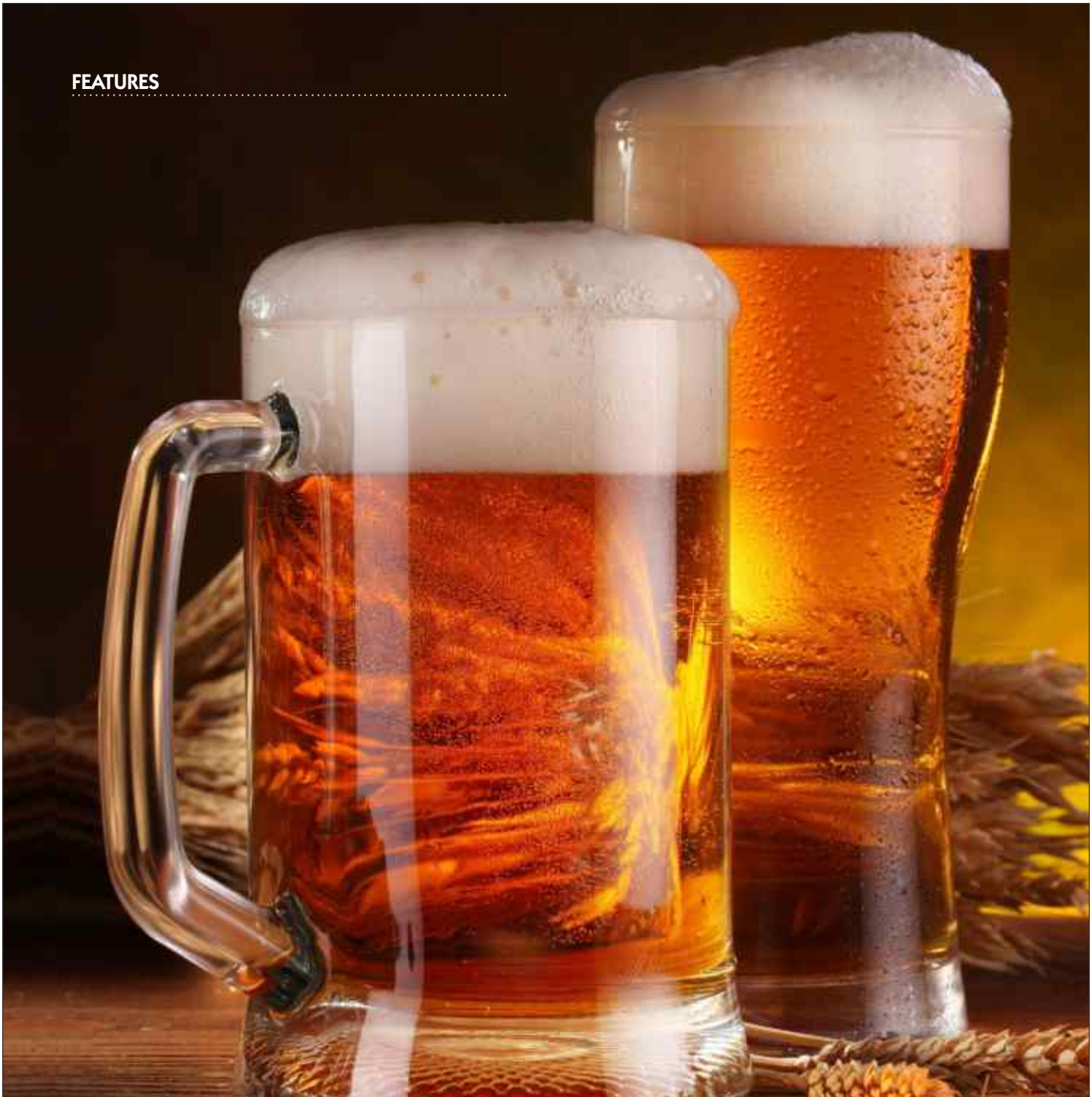

Malt Specifications & Brewing Performance

Rohit Chauhan, Business Development Department

When buying malt, the brewery is looking for a product, which will yield the most economic extract (wort) and will operate satisfactorily under brewhouse conditions and throughout the brewing process. Malt, which is difficult to handle can cause quality and process problems involving additional costs. To ensure that an appropriate malt is supplied the brewer will set and agree a suitable specification with his supplier.

FEATURES

Brewhouse performance of the malt is affected by the interactions between malt quality and:
- The type of brewing process
- The type of brewhouse equipment
- Other materials that are used with the malt e.g. adjuncts

The brewer has certain objectives when purchasing malt:
- To recover a high yield of sugar (extract) from the malt
- That the malt will operate satisfactorily in the plant without additional processing or treatments
- The malt will pass through the plant within the required cycle time (run off time)
- The wort produced from the malt provides all the necessary nutrients to ensure a satisfactory fermentation
- The malt delivers the flavor and process requirements of the brewer and his customers

All of these benefits are supplied on consistent and reliable basis.

MALT SPECIFICATIONS

Barley, and the malt produced, is derived from natural living material, and hence subject to all the variations which can occur as a result of genetic and environmental conditions. It follows that no two batches of malt are alike.

Malt is analyzed in accordance with standard industry tests such as the IoB, EBC and ASBC methods of analysis. However, standard malt specifications are not always a reliable indicator of how well the malt will perform in the brewery. Brewers and maltsters are continually looking for better predictions of brewing performance of a malt.

BARLEY VARIETY

There is a list of approved barley varieties for malting. Each barley variety has its own characteristics through its genetic make-up which will determine certain properties of important to brewing. Some varieties produce better malt than others.

Barley variety will influence malt quality in terms of variables such as:
- % nitrogen or protein in grain (see later)
- % beta-glucan after malting
- Size and homogeneity of grain-plumper grains yield better extracts and are easier to malt and mill. Most brewers specify that all grains should be ≥ 2.2 mm
- Not all barley varieties have similar abilities to produce enzymes, this can be important particularly when using high levels of adjunct.

The environment also influences these factors, e.g. weather, soil type and the use of fertilizer.

The barley variety used to make the malt is considered important not only because of its brewing properties, but because of special characters it gives to the finished beer. Today many traditional ale brewers still specify Maris Otter as they believe it makes better quality beer, even though this variety is no longer recommended because of its poor yield and agronomic performance.

EXTRACT YIELD

Extract is a measure of the amount of sugar recovered from the malt after mashing. The extract value is based on a laboratory mash. There are two basic laboratory procedures used for measuring extract.

- The IoB method, which involves mashing 10% malt with, distilled water and letting the mash stands for 60 minutes at 65°C. The extract is measured as the specific gravity of the filtered solution at 20°C. The results are expressed as litre degrees per kilogram.

• In the EBC (European Brewery Convention) method two mash stand temperatures of 45°C and 70°C are used. The Extract is expressed % sugar (sucrose) over total weight of malt.

Extract value for typical malt made from standard 2-row barley.

Malt extract "dry"	IoB l°/kg	EBC°Plato
Standard ale malt	305 – 315	81 – 82
Standard Lager malt	300 – 310	80 – 81

Both methods give a prediction of brewhouse performance. However under laboratory conditions mashing are not optimized which explains how extract recoveries of greater than 100% can be achieved with more modern mashing and wort separation techniques such as the modern mash filter.

The factors which favor high extract recovery include:
1. Varietal effects: different barley varieties give different yields
2. The total nitrogen content: the higher the nitrogen the lower the extract.
3. Corn size: large even corns size give better malting and milling performance.
4. Modification: the malt should be adequately but not over-modified
5. Enzyme capacity: the malt should have sufficient enzymes to degrade the starch and convert it to simple sugars.
6. Low in gums: extract recovery can be reduced by the presence of gums – particularly beta-glucans in the malt. This problem is often resolved by the addition of exogenous beta glucanase.

MALT NITROGEN (USUALLY EXPRESSED AS % NITROGEN)

The higher the level of nitrogen the lower the % extract. Therefore brewers specify the % nitrogen or protein in malt.

Typical % nitrogen is in the range of :

Ale Malt	1.4 – 1.6%
Lager Malt	1.6 – 1.8%

(Nitrogen is sometimes expressed as % protein which is % nitrogen x 6.25)

However nitrogen plays an essential role in the quality of the beer:

- Nitrogen, in the form of amino acids, is required for yeast growth with typical values of 160 to 240 mg/l depending on yeast strain and wort gravity.

- Hydrophobic nitrogen from the malt provide the beer foam and head retention in beer

- Some long chain polypeptides cause colloidal instability (chill and permanent haze) in beer and have to be reduced in the brewing process.

- Proteins and polypeptides contribute to the texture and mouth feel of the beer. Excessive removal leads to a thin tasting beer with poor foam.

It is important to ensure a avoid excess nitrogen in the barley, but ensure sufficient of the nitrogen available is broken down to soluble nitrogen. The ratio of total to soluble nitrogen is an important indicator or brewing performance. Most of the nitrogen breakdown occurs during malting.

MOISTURE (USUALLY EXPRESSED AS % MOISTURE)

The lower the % moisture, the higher the extract in the malt. Malt specifications express the extract as "extract dry" or "extract as is" – which includes the moisture content.

The darker the malt color, the higher or longer the kilning time. This results in lower % moisture. Because of their darker colorr ale malts tend to have a lower % moisture than lager malt.

Kilning uses a large amount of energy. The next process stage after kilning is mashing when the malt is re-hydrated, There is no benefit in excessive moisture reduction and the trend is to move to higher lager malt moisture to reduce energy costs. For safe storage and good milling performance malt moisture should not exceed 6%.

The higher the moisture, the lower the extract yield per tonne of delivered malt. This has to be adjusted in the price since the brewer wants to pay for malt not water.

Typical % moisture values for standard malts:
Standard ale malt: 2-3% moisture
Standard lager malt: 4-6% moisture

COLOR

During kilning chemical reactions take place between the malt components to produce color compounds. here are a number of color and flavor reactions. The principal reaction is between amino acids and sugars called the “Millard reaction” which produces both color and flavor active compounds.

The higher the kilning temperature, the greater the amount of color compounds produced. As well as producing color, these compounds also contribute to flavor.

The color of the malt is based on the color obtained from the IoB or EBC mash using a 10% solution. This color value provides an approximate indicator of final beer because it is based on a dilute laboratory mash with an original gravity of 1030° (8°Plato). Further color develops during wort boiling.

MODIFICATION

Before the brewer can break down the starch in malt to sugars during mashing, the maltster has to break down the cell structure in the endosperm to make the starch granules accessible. This process is called modification and is the most important measurement when predicting brewing performance and extract yield from malt.

Modification gives a measurement of how evenly the cell structure in the endosperm has been broken down during the malting process.

Enzyme activity starts from the embryo and the aleurone layer surrounding the endosperm to break down the protein and beta-glucan cell walls surrounding the starch granules.

The process of modification has the effect of stripping away the cell wall structure and is shown in the two electron micrographs.

The degree of modification can be measured in a number of ways:

DIRECT OBSERVATION

The electron micrographs clearly show the degradation of the cell walls. This is a complicated and expensive technique for routine analysis.

However, the presence of cell wall material can be detected using a calcofluor stain. The calcofluor dye binds with beta-glucans (cell wall material) and fluoresces under UV light.

Thus if sectioned grains are exposed to this dye those parts of the corn rich in beta-glucan will fluoresce. This technique can be used to determine both the proportion of corns that have modified as well as the extent of modification within individual corns.

By taking a series of transverse sections through the gain it is possible to make direct observation of the endosperm and evaluate the degree of modification. It is found that these observations correlate well with brewing performance.

INDIRECT MEASUREMENTS

Another way of measuring modification is assessing factors influenced by the breakdown of the endosperm structure in the grain:

1. During malting the protein matrix, which surrounds the starch granules inside each storage cell is broken down. The greater the value of soluble nitrogen, the higher the modification. The IoB analysis it is usually expressed as the "Soluble Nitrogen Ratio" (SNR), which is the soluble nitrogen/total nitrogen expressed as a %. The EBC method uses a similar ratio based the EBC mash where it is called the Kolbach Index.

2. Unless the malt is fully modified a number of cells within the endosperm will not be degraded and will remain intact with coarser milling. When the malt is mashed the enzymes will not be able to penetrate the cells and gain access to the starch. These cells are ruptured with fine milling and the extract can be recovered. Another measurement of modification is the course/fine difference, which measures the difference in extract yield between finely and coarsely ground malt. The smaller the difference the better the modification.

3. During malting the cell walls in the endosperm are dissolved away making the grain softer and easier to mill. It is possible to use this property to measure the degree of modification, by measuring the amount of energy required to grind the malt (Friability). The method takes 50 grams of malt which is milled with a constant pressure over a mesh screen. The well modified grain will fall through the screen leaving the chunks of under-modified malt. The weight of ground malt indicates the degree of modification. It also measures the homogeneity or evenness of modification.

4. Cold water extract measures the amount of sugars broken down and released during the malting process. Higher cold water extracts indicate higher modification (see Table 1).

Table 1:
Typical specification for modification in pale ale and well modified lager malt

INDEX OF MODIFICATION	PALE ALE MALT	LAGER MALT
Kolbach % (Sol N/Total N)	38-39	40-43
Course/Fine difference (l°/kg)	3-6	2-3
Friability %	≥95	≥95
Homogeneity %	≥88	≥82
Cold water extract %	1.8-2.0	2.0-2.2

It is important to use malt that has been correctly modified:

- In **under-modified malt** all the cell walls have not been broken down, it usually has a lower soluble protein content (SNR is lower) and there may still be small starch granules present which can give starch conversion and haze problems. Under-modified malt will give brewhouse problems and give poor extract recovery.
- In **over-modified malts** the cell structure is fully broken down, the soluble protein is higher (high SNR) and

most of the small starch granules have be broken down. It is much easier to recover but extract from over modified malt, but some extract may have been used up during the malting process. Excessive nitrogen breakdown may lead to loss of foam positive proteins and poorer beer foam performance.

ENZYME ACTIVITY

The principal activity of malting is to encourage the barley to produce its own enzymes. Some of the enzymes are required during malting to modify the corn structure. The other enzymes, principally the Diastase enzymes (which break down starch) are required to work during mash conversion in the brewhouse.

There are two principle diastatic enzymes:

- Alpha amylase which randomly hydrolyses the starch to produce shorter chains and reduces the viscosity. The activity of the enzyme is measured by the length of time required to break down a standard starch solution to a specific colour standard using an iodine indicator. The activity is expressed as dextrinizing units (DU).

- The other enzyme, beta amylase attacks the non reducing end of the starch chain to produce maltose sugar. The enzymic power is measures as DP (Diastatic Power in °Lintner) in the IoB methods of analysis.

The DP is around 35 – 40 for standard Ale Malts, but can be as high as 100 to 125 for lager malts and over 160 for some high protein six row North American malts. The latter malts have far more enzymic power than they require just to convert the starch from the malt itself and enable the brewer to use high levels of unmalted starch adjuncts.

In EBC analysis the diastatic power is measured as °WK (Windisch-Kolbach units). The value of °WK can be converted to °Lintner by the formula:

$$DP\ °Lintner = (°WK + 16) / 3.5$$

THE CONTRIBUTION OF MALT TO FLAVOR

Malt is the principal ingredient in beer supplying sugar to the yeast which produces alcohol. In addition to sugar, yeast requires a variety of essential nutrients which are necessary for satisfactory yeast growth and nutrition. The typical components required include:

- Simple sugars (glucose, maltose and maltotriose) for fermentation
- Amino acids (free amino nitrogen > 150 mg/l) for yeast growth
- Mineral ions for enzymes – typically zinc, copper etc
- Vitamins for healthy growth
- Some lipid material for cell wall production – although yeast manufactures most of these compounds using available oxygen in the wort.

During fermentation yeast will produce a number of flavor compounds as a direct consequence of metabolizing brewing wort. Changes in wort composition will influence this metabolism and hence the flavor of the beer produced.

Malt also contributes directly to the appearance final character and taste of the beer.

Source: Technical Summary 7 by Tim O'Rourke

Microorganisms in Agriculture: Benefits & Utilization

Rakesh Joshi, Research & Development Department

The uniqueness of microorganisms and their often unpredictable nature and biosynthetic capabilities, given a specific set of environmental and cultural conditions, has made them likely candidates for solving particularly difficult problems in the life sciences and other fields as well. The various ways in which microorganisms have been used over the past 50 years to advance medical technology, human and animal health, food processing, food safety and quality, genetic engineering, environmental protection, agricultural biotechnology, and more effective treatment of agricultural and municipal wastes provide a most impressive record of achievement. Many of these technological advances would not have been possible using straight forward chemical and physical engineering methods, or if they were, they would not have been practically or economically feasible.

Nevertheless, while microbial technologies have been applied to various agricultural and environmental problems with considerable success in recent years, they have not been widely accepted by the scientific community because it is often difficult to consistently reproduce their beneficial effects. Microorganisms are effective only when they are presented with suitable and optimum conditions for metabolizing their substrates Including available water, oxygen (depending on whether the microorganisms are obligate aerobes or facultative anaerobes), pH and temperature of their environment. Meanwhile, the various types of microbial cultures and inoculants available in the market today have rapidly increased because of these new technologies. Significant achievements are being made in systems where technical guidance is coordinated with the marketing of microbial products. Since microorganisms are useful in eliminating problems associated with the use of chemical fertilizers and pesticides, they are now widely applied in nature farming and organic agriculture (Higa, 1991; Parr et al 1994).

Environmental pollution, caused by excessive soil erosion and the associated transport of sediment, chemical fertilizers and pesticides to surface and groundwater, and improper treatment of human and animal wastes has caused serious environmental and social problems throughout the world. Often engineers have attempted to solve these problems using established chemical and physical methods. However, they have usually found that such problems cannot be solved without using microbial methods and technologies in coordination with agricultural production (Reganold et al., 1990; Parr and Hornick, l992a).

For many years, soil microbiologists and microbial ecologists have tended to differentiate soil microorganisms as beneficial or harmful according to their functions and how they affect soil quality, plant growth and yield and plant health. Beneficial microorganisms are those that can fix atmospheric nitrogen, decompose organic wastes and residues, detoxify pesticides, suppress plant diseases and soil-borne pathogens, enhance nutrient cycling, and produce bioactive compounds such as vitamins, hormones and enzymes that stimulate plant growth. Harmful microorganisms are those that can induce plant diseases, stimulate soil-borne pathogens, immobilize nutrients, and produce toxic and putrescent substances that adversely affect plant growth and health.
A more specific classification of beneficial microorganisms has been suggested by Higa (1991; 1994; 1995) which he refers to as "Effective Microorganisms" or EM. This report presents some new perspectives on the ole and application of beneficial microorganism, including EM, as microbial inoculants for shifting the soil microbiological equilibrium in ways that can improve soil quality, enhance crop production and protection, conserve natural resources, and ultimately create a more sustainable agriculture and environment The report also discusses strategies on how beneficial microorganisms, including EM. can be more effective after inoculation into soils.

THE CONCEPT OF EFTECTIVE MICROORGANISMS: THEIR ROLE AND APPLICATION

The concept of effective microorganisms (EM) was developed by Professor Teruo Higa, University of the Ryukyus, Okinawa, Japan (Higa, 1991; Higa and Wididana, 1991a). EM consists of mixed cultures of beneficial an naturally-occurring microorganisms that can be applied as inoculants to increase the microbial diversity of soils and plant. Research has shown that the inoculation of EM cultures to the soil/plant ecosystem can improve soil quality, soil health, and the growth, yield, and quality of crops. EM contains selected species of microorganisms including predominant populations of lactic acid bacteria and yeasts and smaller numbers of photosynthetic bacteria, actionmycetes and other types of organisms.

All of these are mutually compatible with one another and can coexist in liquid culture. EM is not a substitute for other management practices. It is, however, an added dimension for optimizing our best soil and crop management practices such as crop rotations, use of organic amendments, conservation tillage, crop residue recycling, and bio control of pests. If used properly, EM can significantly enhance the beneficial effects of these practices (Higa and Wididana, 1991b). Throughout the discussion which follows, we will use the term "beneficial microorganisms" In a general way to designate a large group of often unknown or ill-defined microorganisms that interact favorably in soils and with plants to render beneficial effects which are sometimes difficult to predict. We use the term "effective microorganisms" or EM to denote specific mixed cultures of known, beneficial microorganisms that are being used effectively as microbial inoculants.

Reference: Dr. Teruo Higa, International Nature Farming Research Center Atami, Japan 1994.

IMPORTANCE OF EFFECTIVE COMMUNICATION IN AN ORGANIZATION

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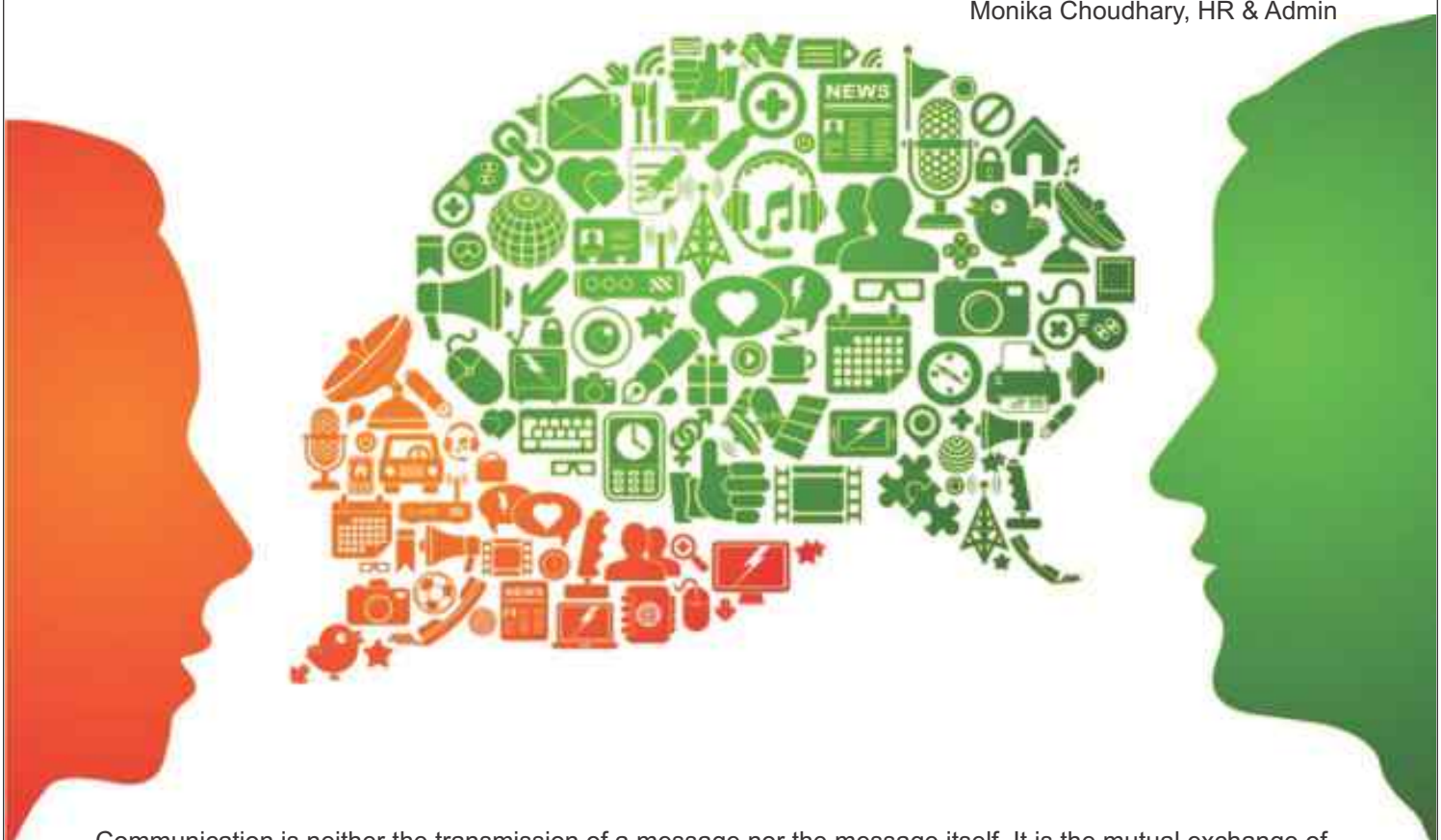


Communication is neither the transmission of a message nor the message itself. It is the mutual exchange of understanding, originating with the receiver. Communication needs to be effective in business. Communication is the essence of management. The basic functions of management (Planning, Organizing, Staffing, Directing and Controlling) cannot be performed well without effective communication.

Business communication involves constant flow of information. Feedback is integral part of business communication. These days organizations are very large and involve large number of people. There are various levels of hierarchy in an organization. Greater the number of levels, the more difficult is the job of managing the organization. Communication here plays a very important role in process of directing and controlling the people in the organization. Immediate feedback can be obtained and misunderstandings if any can be avoided. There should be effective communication between superiors and subordinated in an organization, between organization and society at large (for example between management and trade unions). It is essential for success and growth of an organization. Communication gaps should not occur in any organization.

Business Communication is goal oriented. The rules, regulations and policies of a company have to be communicated to people within and outside the organization. Business Communication is regulated by certain rules and norms. In early times, business communication was limited to paper-work, telephone calls etc. But now with advent of technology, we have cell phones, video conferencing, emails, satellite communication to support business communication. Effective business communication helps in building goodwill of an organization.

Business Communication can be of two types:

1. **Oral Communication**
   An oral communication can be formal or informal. Generally business communication is a formal means of communication, like : meetings, interviews, group discussion, speeches etc. An example of Informal business communication would be - Grapevine.

2. **Written Communication**
   Written means of business communication includes - agenda, reports, manuals etc

Effective communication is important for the development of an organization. It is something which helps the managers to perform the basic functions of management- Planning, Organizing, Motivating and Controlling. Communication skills whether written or oral form the basis of any business activity.

Communication serves as the foundation of every facet of a business. Thus, it can be said that effective communication is the building block of an organization. Some of the benefits of effective communication skills are:

- Communication keeps the foundation of motivation. It helps the employer to know how a job is being performed and to improve performance if it is not up to the mark.
- Communication acts as a source of information and helps in the decision making process and helps in dentifying the alternative course of action.
- Communication also helps in building people's attitude. A well informed person will always have better attitude than a less informed person. Different forms of communication like magazines, journals and meetings will help the employees to form different attitudes.
- In the current business scenario, no business can survive in isolation. Socializing is very important and communication is the tool that helps in socializing.
- Apart from the other functions of management, it also helps in the controlling process of management. It allows the managers to know about the grievances of the subordinates and helps the subordinates to know about the policies of the organization.

Communication is one of the basic features of management. It is instrumental in raising the morale of the employees. It is through communication, verbal or non-verbal, that people submit different feedback and requirements to the management.

Communication can be a tricky concept to master within an organization, particularly one with complex levels and multiple issues. When all parts of your organization communicate smoothly, it can improve workflow and overall productivity. By making an effort to improve your communication processes, you can build a stronger company that will have staying power in the market.

Diet and Nutritional Tips to Stay Healthy in Monsoon Season

We are so good to welcome the monsoon showers after experiencing the scorching summer heat. But monsoons do bring certain health risks. Our body is more susceptible to health issues in rainy season, because monsoon reduces the immunity power of our body. Our body constantly gets affected with allergies, infections, indigestion problems, so we must keep our body resistant against such diseases. The humidity in the atmosphere is usually high in this season; as a result the body's digestive capability goes down. The important point to keep in mind is that you must avoid oily food, street food or any type of food that is prepared in bulk else there is a possibility that it upsets your stomach.

Never eat if you are not feeling hungry, this is a solid cardinal mantra in monsoons. Doing so results in indigestion problems and illness. So, here are some specific guidelines regarding what to eat and what not to eat during rains.

NUTRITIONAL TIPS IN MONSOON:

The damp and filthy conditions in monsoon plays a host for many disease causing germs, which cause some serious health attacks like dengue, malaria, conjunctivitis, typhoid, viral fever, pneumonia, gastro intestinal disturbances, diarrhea and dysentery. If your immune system is weak you are supposed to catch these diseases instantly. To maintain healthy diet and protect you from such ill causes during the rainy season these

countermeasures have to be taken.

- Eat fruits as they help you restore energy. Apples, mangoes, pomegranates, and pears are best suggestible. Avoid watermelon and muskmelons and also goosing on too many mangoes may cause pimples.

- Have medium to low salt food and avoid heavy salty food as they are responsible for high blood pressure and water retention.

- Eating watery foods like lassi, watermelon, rice, muskmelon creates swelling in the body. So, better opt for foods which are drying in nature like corn, gram flour, chick pea etc.

- Foods such as brown rice, oats, and barley are the best foods one could have in this monsoon.

- Body's immunity can be increased by adding a dash of garlic to the soups, sir fries and curries you intake.

- Opt for yogurt, curd and almonds in your diet instead of milk. Drink only boiled and purified water to protect yourself from harmful germs and drinking plenty of water keeps your body hydrated.

- Consuming bitter vegetables like bitter gourd, and bitter herbs like neem, turmeric powder and methi seeds help in preventing infections.

- Consume drying oils like corn oil or light oil and avoid heavy oils like sesame oil, peanut oil and mustard oil as they fall in first place to invite infections.

- People who face skin allergies during rainy seasons must avoid spicy foods. Spicy foods raise body temperature and stimulate blood circulation and it leads to allergies and skin irritation. Other problems such as boils, change in skin color dullness, rashes, pyodera are also some skin damaging effects which arise in this season.

- Drink lots of herbal teas, especially those with antibacterial properties. These include ginger, pepper, honey, mint and basil leaves. Excessive intake of coffee and tea dehydrates body fluids so they must be better avoided.

- Avoid naturally sour foods like tamarind, tomatoes and lime in your diet as it promotes water retention.
- Avoid too much of fish and meat this season and heavy curries and non- vegetarians should go for light meat preparations like stew and soups.
- Astringent, mildly bitter and pungent foods must be best served this season.
- Vegetables like cauliflower, potatoes, cluster beans, ladies finger, kidney beans, pigeon pea, and sprouted grains must be avoided.
- Eat steamed salads instead of raw vegetables as they contain active bacteria and virus that cause bacterial and viral infections.
- Have fresh radish juice to fight cold and cough. To reduce mucous formations add pipli and rock salt to warm water. This reduces the natural monsoon ailments.
- Better eat seasonal fruits as non- seasonal fruits get infested with worms during the monsoons
- Pomegranates, lychees, apples, bananas are among the recommended
- Avoid eating fried items, pre- cut fruits and juices from road side vendors and stick to high quality and hygiene
- Always wash vegetables well and keep them clean especially if they are taken raw

Following these guidelines helps you to stay safe and healthy during monsoons. Always binge on nutritional food and be hygienic by taking necessary precautionary measures like cleaning your house, washing hands before and after having a meal, etc.

Have a safe and healthy monsoon!!

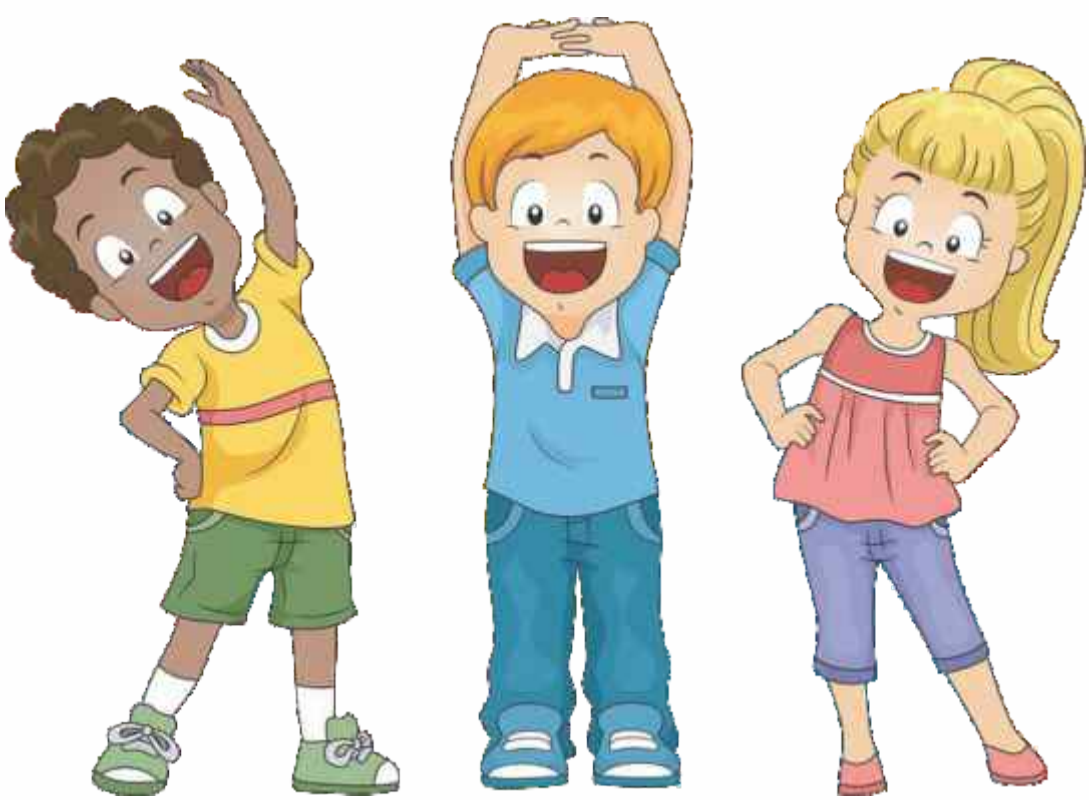
A HEALTHY MIND IN A HEALTHY BODY- AND A MUCH HAPPIER LIFE!!!

For most parents, topping in examinations is usually the priority. Children are left with no time for any play, exercise or outdoor games. The analysis of such grooming brought out some eye opening results. Some of the toppers did extremely well in the initial years of their professional lives. Thereafter they were wash-outs. They burnt out fast owing to their inability to cope with the physical stress and strain of their professional lives and the resultant mental tension, thereby falling by the wayside.

Today's children are tomorrow's citizens. And tomorrow's fit or unfit citizens will be responsible for the country's unity, integrity, safety, security and sovereignty. Hence, every organ of the nation should be manned by people with fit bodies and healthy minds. To have a sound mind in a sound body, you need to keep the following in mind :

1. STAY PHYSICALLY ACTIVE

Moving around and playing help to maintain a healthy body. Children should be encouraged to play outdoor games rather than getting addicted to mobile phones and TV. Playing group games help them make friends and become socially more active.



2. CHALLENGE YOUR MIND

The old saying “use it or lose it” applies to our brain and muscles alike. “Many new lines of research show that the human brain has much more plasticity than previously thought”. In many ways, it’s like a muscle. Challenging the brain to learn new things-by reading, taking up a language, doing crossword puzzles, or playing a musical instrument, for example-can help keep the brain and informational processing in top form and may even reshape brain circuitry.

3. EAT A DIET ABUNDANT IN FRUITS AND VEGETABLES

Researchers are only beginning to understand the many healthful components in plant-based foods that help protect against chronic diseases. For a healthy brain, antioxidants such as vitamin C, E, and A may be especially important. Dozens of studies have shown that foods high in antioxidants, such as blueberries and walnuts, slow age-related decline of brain function in laboratory animals.

8. STAY CONNECTED WITH FRIENDS AND FAMILY

Living alone and being socially isolated is a risk factor for many healthy problems, including depression, memory loss and mental decline. Playing and outdoor activities are an ideal way for families and friends to get to know each other well, especially so for children for whom it is a god way to develop social skills and become socially more active.

“There is only one life and that life is the ‘happening life’ of today. Today is the real life. Tomorrow is the uncertain, unknown and unseen life. And the past is the known experience of life, a life which is gone. Take care of this life & ensure a healthy mind in a healthy body.”

KEEP SMILING... BE HEALTHY!!

Potatoes, Eggs & Coffee Beans

Once upon a time a daughter complained to her father that her life was miserable and that she didn't know how she was going to make it. She was tired of fighting and struggling all the time. It seemed just as one problem was solved, another one soon followed.

Her father, a chef, took her to the kitchen. He filled three pots with water and placed each on a high fire. Once the three pots began to boil, he placed potatoes in one pot, eggs in the second pot, and ground coffee beans in the third pot.

He then let them sit and boil, without saying a word to his daughter. After 20 minutes he turned off the burners. He took the potatoes out of the pot and placed them in a bowl. He pulled the eggs out and placed them in a bowl.

He then ladled the coffee out and placed it in a cup. Turning to her he asked. "Daughter, what do you see?"

"Potatoes, eggs, and coffee," she hastily replied.

"Look closer," he said, "and touch the potatoes." She did and noted that they were soft. He then asked her to take an egg and break it. After pulling off the shell, she observed the hard-boiled egg. Finally, he asked her to sip the coffee. Its rich aroma brought a smile to her face.

"Father, what does this mean?" she asked.

He then explained that the potatoes, the eggs and coffee beans had each faced the same adversity– the boiling water.

However, each one reacted differently.

The **POTATO** went in strong, hard, and unrelenting, but in boiling water, it became soft and weak.

The **EGG** was fragile, with the thin outer shell protecting its liquid interior until it was put in the boiling water. Then the inside of the egg became hard.

However, the **GROUND COFFEE BEANS** were unique. After they were exposed to the boiling water, they changed the water and created something new.

"Which are you," he asked his daughter. "When adversity knocks on your door, how do you respond? Are you a potato, an egg, or a coffee bean? "

MORAL:

In life, things happen around us, things happen to us, but the only thing that truly matters is what happens within us.

WHICH ONE ARE YOU?

Health Checkup Camp

Good health is the state of all-round physical, social and mental well-being of a person. Good health is not only important but is also an essential ingredient for a happy life. A healthy person is able to work and live on his own.

As health plays a key role, in association with Shanti Gopal Hospital (Indirapuram), Catalysts had arranged a health check-up camp for the employee and their Family Members.

Table Tennis Tournament

Celebrations @ Catalysts









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