REVIEW ON PHYSIOLOGY OF FUNGI

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Abstract: **Fungal physiology refers to the nutrition, metabolism, growth, reproduction, and death of fungal cells. It also generally relates to interaction of fungi with their biotic and abiotic surroundings, including cellular responses to environmental stress. The physiology of fungal cells impacts significantly on the environment, industrial processes, and human health. In relation to ecological aspects, the biogeochemical cycling of carbon in nature would not be possible without the participation of fungi acting as primary decomposers of organic material. In agriculture fungi play important roles as mutualistic symbionts, pathogens, and saprophytes, where they mobilize nutrients and affect the physicochemical environment, or can be exploited as agents of biocontrol or as biofertilizers. Fungal metabolism is also responsible for the detoxification of organic pollutants and for bioremediating heavy metals and other recalcitrant chemicals in the environment (including wastewaters and ground waters). Therefore, studies of fungal physiology are very pertinent to our understanding, control and exploitation of this group of microorganisms. This review discusses recent information on nutrition, metabolism, growth, reproduction, and death of fungal cells.**

Keywords: **Fungi, Physiology, Nutrition, Metabolism, Materials transport, Reproduction, Growth, Death.**

1. INTRODUCTION

Fungi, being devoid of chlorophyll, are incapable of manufacturing their food by utilizing carbon dioxide of the atmosphere. They are, therefore, one of the heterotrophic organisms. They obtain their nutrition from the substrates on which they grow by breaking down complex compounds into simpler ones with the help of a variety of enzymes secreted from the growing tips of their hyphae. These compounds act as a source of food and energy required for the development of the fungus. Fungal physiology refers to the nutrition, metabolism, growth, reproduction and death of fungal cells. It also generally relates to interaction of fungi with their biotic and abiotic surroundings, including cellular responses to environmental stress (Walker and White, N.A. 2017). The physiology of fungal cells impacts significantly on the environment, industrial processes and human health. The production of many economically important industrial commodities relies on the exploitation of fungal metabolism and these include such diverse products as whole foods, food additives, fermented beverages, antibiotics, probiotics, pigments, pharmaceuticals, biofuels, enzymes, vitamins, organic and fatty acids, and sterols. Moreover, Crop losses from plant-pathogenic fungi can, for example, be catastrophic: blast, wilt and rust fungal diseases all significantly impact upon yield, and their control is a significant component of the costs incurred by farmers (Staples, 2000). Contamination of food and feed with mycotoxins particularly the carcinogen afflation also has far-reaching health implications (Calvo *et al.,* 2002).

2. DIGESTION IN FUNGI

As it has been explained in the introduction part of this paper, fungi are hetrotrophic, organisms so they must absorb dissolved and partially broken down inorganic and organic food materials (nutrient elements). Thus, they secrete digestive enzymes and then absorb the soluble and partially brown down digestion products. (Johnson, 1986; Alexo Poulos, 1997; Mehrotra, 1980; Jennings, 1990).

3. ABSORPTION IN FUNGI

Fungi absorb their food after digesting it externally by secreting enzymes. This unique mode of nutrition, combined with their filamentous growth form and complete lack of flagella, makes the members of this kingdom highly distinctive (Johnson and1986). Fungi do not fix carbon and the nutrients that enter their bodies must pass through the cell wall and plasma membrane (Alexo Poulos, 1997) and this characteristic has prompted some individuals to describe fungi as organisms whose "stomachs" are outside their bodies. This is because instead of first ingesting foods and then digesting them as animals do, fungi first must realse digestive enzymes into the external environment and these enzymes breakdown large and relatively insoluble molecules such as carbohydrates, proteins, and lipids into smaller and more soluble molecules that then can be absorbed. The same concept was described by different scholars that studied about physiology of fungi (Mehrotra, 1980; Jennings, 1990; Rothstein, 1966). According to Mehrotra (1980) nutrients required by fungi are absorbed by two mechanisms (processes) : Passive process (both simple and facilitated diffusions) and active process-against concentration gradient.

4. TRANSPORT OF MATERIALS IN FUNGI

The acquisition of nutrients by a fungus is dependent on their transport across the plasma membrane of those hyphae involved in exploiting a substrate (Jennings, 1990). All nutrients substances must be transported through two outer membranes of a fungus, its cell wall and cytoplasmic membrane, before they can be utilized metabolically, but it has been found that only the cytoplasmic membrane is responsible for the regulation of transport by the cell (Mehrotra, 1980). This indicates that acquisition of nutrients by a fungus is dependent on their transport across the plasma membrane of those hyphae involved in exploiting a substrate. Rothstein (1965) consider this thin membrane as a traffic regulator of uptake of substances by fungal hyphae and he described that no substance can leaves or enter a cell without being subjected to the traffic rules that are inherent in nature of the plasma membrane. Thus, by carefully determining these traffic rules that apply to various substances, the cell physiologist hope not only describe the balance and flow of substances into and out of the cells, but also can determine the underlying mechanisms within the membrane (Rothstein 1967). It has been also found that the plasma membrane plays a role in degradation and synthesis of extra cellular substances (Rothstein, 1967).

4.1. MECHANISM OF MEMBRANE TRANSFER

Net movement of solute across the plasma membrane will take place only if a driving force acts on that particular suite, and if some means exist for the solute molecule to pass through the plasma membrane (Rothstein, 1967). In general there are two types of net movement driving forces. The first and the most common driving force is a force that drives solutes from their higher electro potential area to the lower electro potential area (i.e. on the two sides of the membrane) such movement of solutes is called diffusion and the process is termed as passive transport (i.e., transport of solutes without the expenditure of the cell's energy). The second type of driving force is a force that driven physiologically important solutes against their electro chemical potential gradients and is called "Uphill" or active transport. This uphill transport of solute requires energy from the metabolic reactions of the cell (i.e. transport of solutes with the expenditure of energy). (Rothstein, 1967; Mehrotra, 1980,)

4.1.1. Movement of non-electrolytes across the plasma membrane

The net movement of non- electrolyte solutes across the plasma membrane is also governed by driving forces. The driving force for the movement of these solutes is the chemical difference, i.e. the concentration difference/gradient of the substances between the inside and outside solution of the cell or the two sides of the plasma membrane.

4.1.2. The movement of Electrolytes across the Plasma Membrane

As to the movement of electrolytes substances (solutes) across the plasma membrane, the electrical potential/gradient across the membrane as well as the chemical potential can serve as a driving forces and the net driving force is usually referred to as the electro chemical potential/ gradient. If no other forces intervene, the net movement will cease when the electro chemical potential is zero, and the solute reaches at equilibrium distribution. But if the solute is continuously removed or added to one side of the membrane, then equilibrium is never reached and will continue to move. Movement of solutes in response to driving forces outside of the membrane is usually called "downhill" or "passive".

The movement of many physiologically important solutes through the plasma membrane cannot be accounted for by the external gradients. Other forces operating within the membrane push the solutes against their electrical gradients; such movements are generally called "uphill" or "active transport", the required energy being derived from metabolic reactions. Usually solutes that can be actively transported in the "uphill" direction can also more in the "down hill" direction as well. In this case a steady state distribution is attained, in which an electro chemical gradient is maintained, and in which the "uphill" movement is exactly balanced by the "down hill" movement. This situation is sometimes called "pump and leak" system.

The concept of carriers has developed in the last 20 years primarily to explain the behaviors of many physiologically important solutes (Rothstein, 1967). The kinetics of transport in this case cannot be explained by a diffusion limited process, or by bulk flow, but it can be explained by assuming that the solute must form a chemically specific complex with a receptor site in the membrane in order for transfer to occur. The general properties of carrier systems can be summarized briefly as follows: 1. Saturation by high concentrations of solute, resulting in a maximal rate of transfer. 2. Inhibition by small amount of specific inhibitors indicating that the carries occupy only a small fraction of the membrane surface.3. Linkages, often seen between the solute movements in opposite directions. For example, the movement of one sugar into the cell can accelerate the movement of a different sugar in the opposite direction

In the case of ions movements, the linkage may be obligatory; an ion can be transferred in one direction only if another ion of the same charge is simultaneously transferred in the other direction (called "forced exchange"). Generally carrier mediated transfer of solute may result from driving forces arising from the external electro chemical gradient/ or from internal gradients generated with in the membrane by active transport mechanisms. In the latter case, metabolic reaction are required to maintain an asymmetry in the distribution of the carriers across the membrane so that solute is transferred faster in one direction than in the other.

4.1.3. Translocation (Intracellular Transport)

Translocation is the movement of substances within a hypha from their point of entry to any given point bounded by the cell wall of that hypha. A hypha is considered here as a protoplasmic system bounded or limited from the external environment by a continuous cell wall. This includes the septa within the confines of the vegetative hyphae and the partitions that separate the condia or other speculating structures from the vegetative phase. It is assumed that the protoplasm is continuous throughout a given fungal system (Hill, 1967). In translocation substances are translocated (moved) from one part of the mycelium to another. Translocation is towards the growing front and/or into spore producing structures.

As to the mechanism of translocation, the cytoplasmic streaming is considered to be the main method of transport of substances from one part of a hypha to another. The direction of streaming is usually from older to younger hyphae since the synthesis is of protoplasm is believed to take place in old hyphae and move to the growing front. Not only this, but also there is other causes for cytoplasmic streaming. This is the increase in vacuole size effected by osmotic pressure changes. In this case the pressure of the enlarging vacuole up on protoplasm forces it to move in the direction of least resistance resulting in the movement. The increase in vacude size may be due to osmotic changes. Thus, increase in the amount of protoplasm, couple with the increase in the size of vacuole, may force the protoplasm to move. Septation in hyphae apparently do not stop the flow of the cytoplasm but do reduce its rates.

5. METABOLISM IN FUNGI

Metabolism is the sum total of the biochemical reactions that exist within the cell. It is the process by which cells extract energy from their environment and synthesize the building blacks of their macromolecules. Each process is enzymatically catalyzed and involves a number of specific compounds. Fore example, the break down of macromolecules into smaller units and the synthesis of macromolecules from smaller units are enzyme catalyzed reactions. (Meseret Chimdessa, 2006).Since fungi are living things, metabolisms of different substances take place in their body. For example, carbon metabolism, nitrogen metabolism, phosphorus metabolism, etc., are the major metabolic reaction that takes place in fungi. There are two types of major metabolic path ways in living systems: Anabolic and Catabolic metabolism. In anabolic metabolism, reaction results in the synthesis of large molecular weight compounds from simples ones and in catabolic metabolism, reaction leads to the break down of more complex molecules into simpler ones.

5.1. CARBOHYDRATE METABOLISM IN FUNGI

Polysaccharides such as glycogen, Cellulose, Hemicelluloses, Ligning, etc, and the Oligasaccharides such as disaccharides, trisaccharides, Tetrasaccharides are broken down in to their smaller units and resynthesized from their smaller units by their respective enzymes in the fungal body.

5.2. ORGANIC ACIDS AND LIPIDS METABOLISM IN FUNGI

Organic acids and lipids are the final groups of carbon metabolites of fungi (V.W. Cochrane, 1958) organic acids except higher fatty acids of lipids, are formed during carbohydrate catabolism – that is both in anaerobic respiration (Glycolysis) and aerobic respiration (Citric acid cycle) metabolites. As to the fate of these organic acids {intermediate metabolites};they can be converted into amino acids or they can be oxidized to produce energy for the organism or they can flow to other channel (Cochrane, 1958). Some generalization can be made concerning the physiology and biochemistry of these organic acids such as gluconic, citric, fumaric, succinic, lactic, and oxalic acids which are formed in large amounts and which have been studied intensively (Cochrane, 1958).

1. The acids occur, in small amounts at least, as normal metabolites in organisms other than fungi. This is also true of acetate, formate, glyoxylate, and malate.

2. With few exceptions, which are subjects to confirmation – the acids which accumulate in fungus cultures are later utilized for energy and growth unless removed by a trappings agent, eg. Calcium ion, or unless their accumulation poisons the cell.

3. Most experiments agree that highest acid yields, in terms of fraction of sugar converted to product, are obtained in media in which carbohydrate is abundant but in which some other factor, usually nutritional, restricts growth to a less than maximum amount.

4. Oxygen is essential for the synthesis of all but lactic acid: this requirement is, ofcourse, obvious from the structure of acids. Bluecoat formation, catalyzed as it probably is by a flavin enzyme, is the most responsive to oxygen pressure.

5. Carbon dioxide enters by fixation in to lactic, citric, fumeric and succinic acids, and appears to be quantitatively important in providing the carbon of all these except possibly lactate.

In the case of lipids metabolism in fungi, both the anabolic and catabolic aspects of it has been well-studied and well known. The well studied physiologically important lipids to fungi, include- the true fats, the fatty acids, the compound lipids (phospholipids, the sterols, the carotenoids and triterpenes, and a few hydrocarbons.

5.3. THE SYNTHESIS OF FATS, FATTY ACIDS, AND PHOSPHOLIPIDS

The neutral fats are triglycerides of the higher amounts up to 50 percent of the mycelial dry weight. Most fungal lipids contain a high content of free fatty acids compared to that of animals. This means that most experiments on the factors affecting gross lipid content deal indiscriminately with both neutral fats and fatty acids. Study of the formation of fats and fatty acids by fungi has been concentrated on those fungi which form them in large amount particularly species of Endomyces (Endomycopsis), Torula (Torulopsis), and Oospora (Geotrichum, often miscalled odium) among the yeast-like fungi, and Aspergillus, Fusarium, and penicillium among the filamentous fungi. Within any given species the formation of fats varies quantitatively from one strain to another and from clonal culture to another (Cochrane, 1958). Fats are formed intracellularly, possibly in association with cytoplasmic particles. The possibility that different types of cells differ in their capacity to form fat is raised by the work of researchers on Absidia blackesleeana, but other explanations are possible. It is usually assumed that fats are reserve substances, and their disappearance or, more commonly, partial disappearance during the later phases of the culture cycle support this generation. For any given fungus which is genetically of forming fats, environmental conditions determine the amount actually synthesised. For example, the concentration of carbohydrate, more accurately the carbon: nitrogen ration (Cochrane, 1958). As the carbohydrate concentration is increased,the total fat and percentage of conversion of glucose to fat both increase. The other factor corresponding to the carbohydrate effects, is the level of nitrogen which is suboptimal for growth and is generally favorable for maximum fat accumulation. The other factor is phosphate deficiency.If it is not too severe, it increases fat synthesis, probably by reducing the assimilation of nitrogen. Other nutritional determinant includes the essentiality of phosphate and effects of metals, which are definite but not susceptible of generalization. The other factor is pH. Fat

Page | 43

formation in most yeasts and fungi is optimal at neutral or slightly alkaline reaction. The other factor that affects synthesis of fats is oxygen supply. The supply of oxygen is invariably essential for fat synthesis. The synthesis of fatty acids is also affected by concentration of carbohydrate. The content of free fatty acids is greater at high carbohydrate levels. Synthesis of phospholipids has been also studied particularly in *aspergillus niger* and is found to be independent of the fat in its synthesis and is parallel to the available nitrogen of the medium.

5.4. THE BREAKDOWN OF FATS AND PHOSPHOLIPIDS

Although the neutral fats are relatively poor sources of carbon, they are utilized by many fungi. The first step in such utilization is the hydrolysis of the fat to glycerol and fatty acids. It is assumed that endogenous fats are split in the same way before utilization. The hydrolysis is catalyzed by lipase or lipases. The fatty acids of neutral fats can be oxidized to supply energy for the fungi. The process of generating energy from fatty acids is called B-Oxidation since the oxidantion takes place on the 3rd carbon or the B-Carbon (Mesert Chimdessa, ,2006)

$$CH_3 - (CH_2)n - {}^{\beta}CH_2 \, {}^{\alpha}CH_2 \, COOH$$

Phospholipids are hydrolysed, at different points by the phospholipases A,B, and C. Phospholipase A is found in *Aspergillus oryzae* and *Lycoperdon giganteum*, Phospholipase B in the mycelium of *penicillium notatum*, phospholipose C, indentical with glycerolphosphate, is found in a commercial enzyme preparation from *Aspergillus species*.

5.5. NITROGEN AND PHOSPHORUS METABOLISM IN FUNGI

Nitrogen and phosphorus are the two major elements in fungal nutrition. Nitrogen metabolism in *Aspergillus nidulans*, *Neurospora crassa* and *saccharomyces cerevisiae* can use diverse sources of nitrogen including ammonium, nitrite, nitrate, numerous aminoacids, acetamide, purines and proteins (Jennings, 1988). Ammonium, glutamate and glutamine tend to be the favoured sources; use of the others requires the synthesis of necessary enzymes or activation of previously existing enzymes. Maximal growth rates are obtained with these three nitrogen sources and growth on them leads to the most intense depression of a whole range of activities, including membrane transport linked to utilization of other nitrogen compounds. This depression of activates – termed nitrogen catabolic control, regulation or repression- must be lifted if de novo synthesis of enzymes catalyzing other nitrogen compounds is to take place. Nitrogen catabolite control might be considered to be adaptive mechanism which gives priority to the utilization of nitrogen sources. Thus, an amino acids such as argentine is only utilized effectively when ammonium, glutamate or glutamine are absent from the medium. Nitrogen catabolite control is a transcriptional control system that governs many nitrogen – catabolic enzymes and all the evidence is that glutamine acts as the metabolic signal leading to metabolic control (Jenning, 1988). Nitrogen catabolite control can be seen as one aspect of the ability of these three fungi to adapt to a changing environment with respect to the form and amount of nitrogen present. In growing green plants, nitrogen metabolism is envisaged as a flux of the lament from in organic form via amino acid to protein. In fungi, the ability, indeed the necessity, to use a range of nitrogen sources means that both catabolic and anabolic activity must take place simultaneously. For ordered growth to occur there must be sophisticated regulation of metabolism particularly in those situations when common intermediate(s) exist. Perhaps the best studied carbon source has been arginine in which the catabolic pathway consists of the hydrolysis of organine to ornithine and urea, the break down of urea to ammonia and carbon dioxide and the conversion or nithine to glutamate. The anabolic pathway involves the synthesis of ornithine and of carbabamoyl phosphate, with the conversion of these two compounds to arginine.

5.5.1. NItrogen metabolism in fungi

A number of themes could be followed when considering nitrogen metabolism in the less studied fungi. For example, there are the two pathways of lysine biosynthesis in fungi: one involves α, Σ diaminopimelic acid and is associated with the *Oomycetes sensu stricto;* the other in values α – amino adiopic acid and is found in the Chytridiales, Mucorales and the so called higher fungi. The presence of these pathways is associated with other bio chemical features. In particular, NADP, Linked glutamate dehydrognase is confined to the Ascomycotina, Basidiomycotnia and Deuteromycotina within the lower fungi the NAD- linked glutamate dehydrogenases can be divided into three classes on the basis of their regulatory properties. This argues the need for concerted further study of the nitrogen metabolism of lower fungi. There are differences in the specificity of nitrogen sources for growth. All fungi seem able to utilize some kind of organic nitrogen source. The great majority of fungi can use ammonium as the sole source of nitrogen. A number of fungi, can use

nitrate in addition to ammonium but few *Basidiomycotina and saprotegniaceae* have this ability. There are indications that certain plant pathogens are apparently unable to use nitrate or ammonium as a source of nitrogen, and the situation is probably complex. Thus, in the two rust fungi whose nutrition has been found that Gymnosporangium Juniperi – Virginianae can use either.

5.5.2. Phosphorus metabolism in fungi

According to Jemmings (1988) phosphorus is one of the major element in fungal nutrition and it is important to consider the ecological role of this element because it can exist in many chemical forms in natural habitats. Thus, the availability of the various forms might be expected to have very considerable selective influence on the presence of particular species within a habitat. When higher plants are compared to fungi with respect to their available phosphorus in natural habitat, in higher plants, there are many ecological situations where phosphorus is not readily available and this lack of availability is associated with diffusive movement of phosphorus (as phosphate) to plant roots. This is because plant roots absorb soluble phosphorus and insoluble phosphates can not be absorbed. But in the case of fungi, this problem is not widely known. This is because first, mycelium can grow towards source of phosphorus. Second, we know that fungi can utilize sources of phosphorus other than soluble phosphate, namely condensed phosphates, insoluble phosphates and organic phosphorus compounds, including nucleic acids. Further, some fungi, along with some bacteria and actionmycetes, are able to solubilize phosphate through secretions of organic acids. Finally, apart from the large fruit bodies produced by many basidiomycetes and some ascomycetes, fungi unlike higher plants do not have aerial structures to supply with the elements. Thus, fungal growth in nature may not be limited by phosphorus availability in spite of the low levels of phosphorus found in many environments. According to Jennings (1988), polyphosphates are the sources of phosphorus in fungi. Thus, the author believe that polyphosphates should be viewed as part of a micro-organism's armoury of 'metabolic taps' allowing it to function in the varing condition of its external environment. They also can be viewed as components of the homeostatic system equivalent to the hormonal and nervous regulation of multicellular organisms. Polyphosphates may thus play a role equivalent to that ascribed to polyols, namely that these compounds are part of a system of physiological buffering' within fungal protoplasm' such a role of polyphosphates could be played out via a number of metabolic activities. Polyphosphate may act as a higher- energy phosphate alternative to ATP. Micro-organisms have evolved mechanisms for protecting the adenine nucleotide pools against fluctuation in the nutrient content of the environment. Polyphosphates may therefore play a similar protective role. Polyphosphates are also involved in the maintenance of the cation/ anion balance within fungi. It is also known that under certain condition bivalent cations such as magnesium and manganous ions can also be linked to polyphosphate and especially the magnesium may be part of those processes required to regulate the concentration of this bivalent cation with in the cytoplasm, where it plays a significant role in phyosphorus metabolism. With respect to the more general matter of cation/anion balance within a fungus orthophosphate will also contribute to the total negative charge within the cell. There is value in a high proportion of that charge being inorganic, such as ortho- and poly phosphate, since there is less need to produce organic acid anions to balance in coming inorganic cations. In this ways, carbon is conserved for other functions within the organism.Therefore, the break down and synthesis of polyphosphate are two of those several processes which help to regulate cytoplasmic ortho phosphate concentration. Control of phosphorus concentration in the cytoplasm must also occur at the plasma lemma and the tonoplast. Studies showed that in the plasmalemma of the best studied fungus *S. cerevisiael* there appear to be three transport systems for the monovalent anion: (1) a constitutive system which has low affinity for the anion (2) an inducible proton symport; and (3) an inducible sodium symport, both of the latter having a high affinity for phosphate. Derepression of the latter two systems occurs when cells are incubated in the presence of a suitable substrate, such as glucose, in a medium lacking phosphate. This can be prevented by protein synthesis inhibitor cycloheximide. At the same time that there is derepression of the high – affinity system, the low- affinity system disappears. The sum, at any one time, of the maximal rates of uptake by the two systems (constitutive and inducible) is constant, suggesting that the constitutive system is involved in both the high- affinity and low – affinity transport of the anion. According to D.H. Jenning (1988), more recent evidence indicates that the transport system is composed of a cell-wall protein and another in the plasmalemma, that in the wall being involved in the high- affinity system. There is circumstantial evidence that phosphate transport into many fungi is likely to be very similar to what has been found in *S.cerevisiae*, namely that some elements of the system involve proton symport and the kinetics of transport being dependent on the internal phosphorus status of the organisms. These various transport system form part of the 'phosphorus acquisition system' of a fungus. It is clear that many fungi are able to release phosphates from organic form by producing extracellular phosphateses. Thus, these organisms are likely to have within their environment a much greater

source of available phosphorus than the green vascular plants. Clearly then, it seems likely that phosphorus does not limit growth in many environments and the best perspective from which to view the relationship between phosphorus and fungi is probably from the standpoint of the regulation of phosphate concentration within the cytoplasm. This has to be achieved in the face of (1) the various ways that the fungus can acquire phosphate and the rate of transport into the cytoplasm, and (2) the rates of processes within the cytoplasm leading to the net utilization of phosphate. There is clearly control of transport into the cytoplasm and presumably metabolic regulation of those processes utilize in phosphate. In this context the vacuole, where phosphate and polyphosphate might be stored (along with those other sites for the storage of polyphosphate), might be visualized as providing a reservoir to cushion large changes in cytoplasmic phosphate concentration which otherwise could have un to ward effects on metabolism. These ideas can now be investigated experimentally since it is now possible to determine directly cytoplasmic phosphate concentration by 3/p- NMR/ and a suitable organism would be one which could be grown in continuous culture, yet use a variety of phosphorus sources.

6. FUNGAL GROWTH

Fungi grow well under the same conditions that favor the growth of bacteria, warmth and moisture. It is for this reason that fungal infections pose a serious problem to troops in the tropics. As the temperature decreases, fungal activity also decreases; however, the spores are very resistant to cold, some surviving freezing temperatures for long periods of time. On the other hand, fungi are easily killed at high temperatures.

7. FUNGAL REPRODUCTION

Fungi reproduce sexually and/or asexually. Perfect fungi reproduce both sexually and asexually,while imperfect fungi reproduce only asexually (by mitosis). In both sexual and asexual reproduction, fungi produce spores that disperse from the parent organism by either floating on the wind or hitching a ride on an animal. Fungal spores are smaller and lighter than plant seeds. The giant puffball mushroom bursts open and releases trillions of spores. The huge number of spores released increases the likelihood of landing in an environment that will support growth.

7.1. ASEXUAL REPRODUCTION

Fungi reproduce asexually by fragmentation, budding, or producing spores. Fragments of hyphae can grow new colonies. Mycelial fragmentation occurs when a fungal mycelium separates into pieces with each component growing into a separate mycelium. Somatic cells in yeast form buds. During budding (a type of cytokinesis), a bulge forms on the side of the cell, the nucleus divides mitotically, and the bud ultimately detaches itself from the mother cell. The most common mode of asexual reproduction is through the formation of asexual spores, which are produced by one parent only (through mitosis) and are genetically identical to that parent. Spores allow fungi to expand their distribution and colonize new environments. They may be released from the parent thallus, either outside or within a special reproductive sac called a sporangium.

7.2. SEXUAL REPRODUCTION

Sexual reproduction introduces genetic variation into a population of fungi. In fungi, sexual reproduction often occurs in response to adverse environmental conditions. Two mating types are produced. When both mating types are present in the same mycelium, it is called homothallic, or self-fertile. Heterothallic mycelia require two different, but compatible, mycelia to reproduce sexually. Although there are many variations in fungal sexual reproduction, all include the following three stages. First, during plasmogamy (literally, "marriage or union of cytoplasm"), two haploid cells fuse, leading to a dikaryotic stage where two haploid nuclei coexist in a single cell. During karyogamy ("nuclear marriage"), the haploid nuclei fuse to form a diploid zygote nucleus. Finally, meiosis takes place in the gametangia (singular, gametangium) organs, in which gametes of different mating types are generated. At this stage, spores are disseminated into the environment.

8. CONCLUSION

In this review, the physiological diversity of fungi in terms of the nutrition, metabolism, growth, reproduction and death of fungal cells. Understanding the ways in which fungi interact with their growth environment is crucial to control fungal pathogens that create a big problem to human, animals and plants and it is also important in industry to exploit fungi for production of biotechnological commodities. Thus it can be concluded that study of fungal physiology is important with respect to agriculture, human health, environment and industry.

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