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Benefits, challenges and opportunities in mushroom production: A review

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Abstract

Mushroom cultivation as a subsidiary occupation provides ample opportunities for sustaining rural livelihood. One of the benefits of mushroom cultivation is their potential contribution to a more sustainable and environmentally-friendly way of farming. Mushroom cultivation using an agricultural waste as a growing medium, and the subsequent use of spent substrate has high value for horticultural activity; organic fertilizer; and potential utilization for animal feeding. Mushrooms are popular valuable foods because they are low in calories, carbohydrates, fat and sodium also, they are cholesterol-free. Besides, mushrooms provide important nutrients, including selenium, potassium, riboflavin, niacin, vitamin D, proteins, and fiber. Nutritional value of mushrooms lies between that of meat and vegetables. Mushrooms are important for their healing capacities and properties in traditional medicine. It has reported beneficial effects for health and treatment of some diseases. Many nutraceutical properties are described in mushrooms, such as prevention or treatment of Parkinson, Alzheimer, hypertension and high risk of stroke. They are also utilized to reduce the likelihood of cancer invasion and metastasis due to antitumoral attributes. Constraints in mushroom production is highly perishable, lack of marketing facility, infected spawn, non-possession of technical knowledge, low risk bearing capacity, lack of technical guidance, lack of flow of information, non-availability of spawn in time, non-availability of quality straw, lack of involvement of Govt. In this paper, nutritional, medicinal, economic, environmental values and constraints in mushroom production were discussed.

Keywords: Mushroom cultivation, benefits, agricultural residues, nutrients

1. Introduction

Mushrooms are being grown on a commercial scale in many parts of the world. In India, commercial mushroom farming started recently, Himachal Pradesh, Punjab, Haryana, Uttar Pradesh, Maharashtra, Tamil Nadu, Karnataka Andhra Pradesh is a major mushroom producing state. Sonipat, Panipat and Gurgaon are the three districts in Haryana that produce major mushrooms. In Haryana mainly two species (White button and Oyster mushroom) are cultivated which are grown at commercial level. Mushroom farming is such a component of the farming system that not only imparts diversification but also helps in addressing the problems of quality food, health and environment related issues (Atkin, 1972) [3]. Mushrooms are one of the most diverse organisms on earth and since primitive times have played a vital role in human welfare (Martinez –ibarra *et al.*, 2019) [15]. Its major role is in the conservation of natural resources as well as increasing the recycling of agro-wastes including agro industrial waste. Mushroom cultivation is a highly profitable and sustainable enterprise for small and marginal agricultural laborers. Farmers who are not getting good returns from agriculture are also keen to adopt other agriculture related activities to enhance their income and mushroom cultivation is one of them, which provides extra income to the farmers other than field crops in two to three months duration. Since mushroom cultivation does not require big land and can be grown in the houses, small huts, people having limited or no land are also showing interest in starting mushroom cultivation as an venture of income generation. Mushroom cultivation is the most economical way of upgrading lingo cellulolytic waste and hence, is the way to increase the income of the farmers other than field crops, which ultimately increase the human resource directly or indirectly (Singh *et al.*, 2003) [30]. Moreover, the diversity in soil and climatic conditions in India allows the production of a variety of mushrooms in different parts of the country. This provides vast potential for the cultivation of mushrooms due to ample availability of raw materials and conducive climatic conditions.

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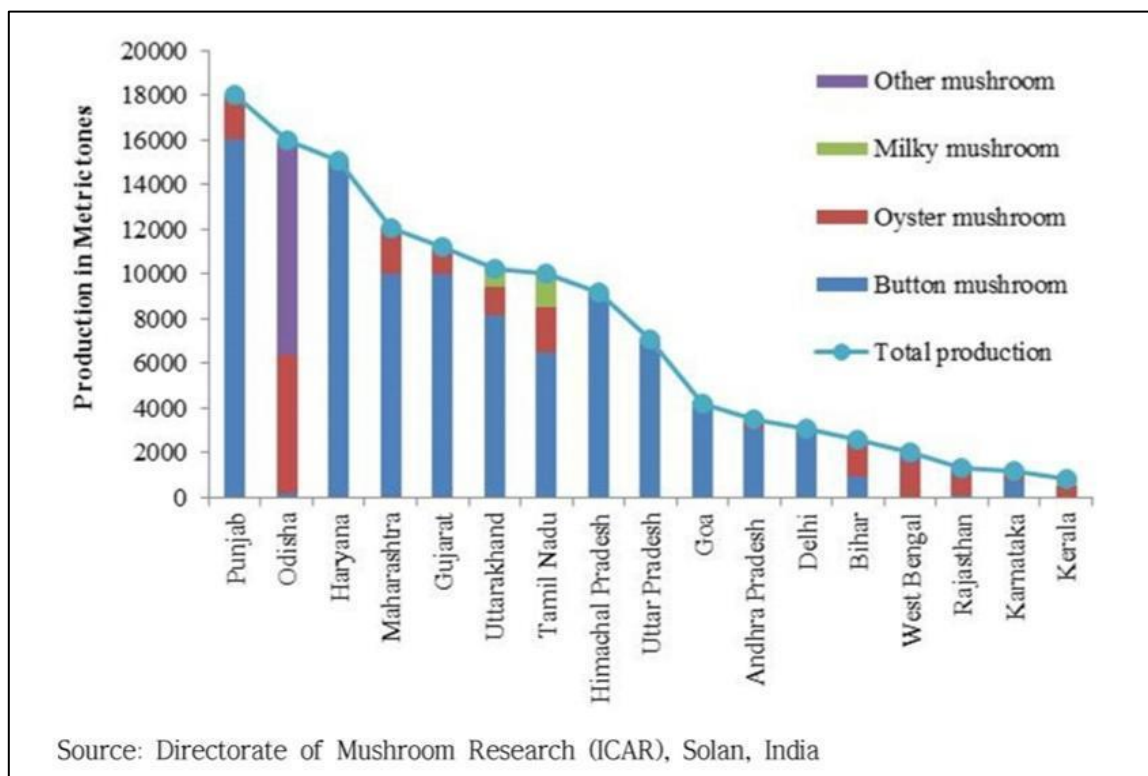


Fig 1: Relative contribution and domesticated mushroom species

Mushroom cultivation can help reduce vulnerability to poverty and strengthen livelihoods through the generation of a fast yielding and nutritious source of food and a reliable source of income (Marshall and Nair, 2009) [14]. The fresh mushroom contains about 85-90 % moisture, 3 % protein, 4 % carbohydrates, 3-4 % fats and 1 % minerals and vitamins as well as some medicinal properties like lowering blood cholesterol levels, defense against cancer and invigorating hair growth (Miah., 2017) [17]. In recent years, mushrooms have also been seen as one of the most interesting subjects of the search for natural antimicrobial agents (Singh *et al.*, 2014) [31]. Chang (2012) [5] reports that mushrooms provide many of the nutritional attributes of produce, as well as attributes more commonly found in meat, beans or grains. On a fresh weight basis, mushrooms are superior in protein content (Aremu *et al.*, 2009) [2] to all vegetables and fruits, but are inferior to meat and dairy products, which are the conventional protein sources. On a dry-weight basis, however, mushrooms are similar with respect to dried yeast and superior to dried peas and beans.

Patel and Goyal (2013) [19, 20] reported that mushrooms act as anti-cancer compounds play crucial role as reactive oxygen species inducer, mitotic kinase inhibitor, antimutagenic, angiogenesis inhibitor, topoisomerase inhibitor, leading to apoptosis, and eventually checking cancer proliferation. Most mushroom derived preparation and substances find their use not as pharmaceutical but as a novel class of dietary supplements (DS) or "nutraceutical". A mushroom nutraceuticals is a refined or partially refined extract or dried biomass from either the mycelium or the fruiting body of the mushroom, which is consumed in the form of capsule or tablets as a dietary supplement and which may enhance the immune response of human body, thereby increasing resistance to disease and in some cases causing regression of a disease state. Many pharmaceutical substances with potent and unique properties were isolated from mushrooms and distributed worldwide. Extensive clinical studies have

explicitly illustrated that a number of mushroom species have medicinal and therapeutic value in the prevention /treatment of cancer, viral disease, hypercholesterolemia, blood platelet aggregation, and hypertension etc.

There are some problems during cultivation and marketing, which are essential to be addressed and as such steps could be taken to boost production of this crop (Rahman, 2018) [21]. However, very little information is known about the status of mushroom production potential benefits, challenges and opportunities. Therefore, this study so far reviews the available information on mushrooms.

2. Methodology: This paper is more a review and synthesis. The data are acquired from secondary sources.

3. Benefits of mushroom

3.1 Nutritional Benefits

Mushrooms are well-suited to supplement diets which lack proteins and in a sense they are rightly called "vegetable meat". Carbohydrate and fat contents of edible mushrooms are quite low. Owing to these attributes, these serve as low-caloric diets recommended to heart patients. Mushrooms have both a nutritional and medicinal value (Hobbs *et al.*, 1995) [9]. Mushrooms have a high percentage of water 93-95% as compared to raw beef (70%) and fresh vegetables (92%). The absence of starch in mushrooms makes it an ideal food for diabetic patients and for persons who want to shed excess fat. The low total fat content, and high proportion of polyunsaturated fatty acids (72-85%) relative to total fatty acids, is considered a significant contribution to the health value of mushrooms. They can be successfully used as appetizers in marinated form and also as an ingredient in soups, sauces, salads, stuffing and meat dishes. Chang (2012) [5] reports that mushrooms provide many of the nutritional attributes of produce, as well as attributes more commonly found in meat, beans or grains. Mushrooms are low in calories, fat-free, cholesterol-free and very low in sodium.

Mushrooms have high protein content (up to 44.93%), vitamins, fibers, minerals, trace elements, and low calories and they lack cholesterol (Mhanda *et al.*, 2015) ^[16]. The absence of starch in mushrooms makes it an ideal food for diabetic patients and for persons who want to shed excess fat. Have demonstrated that mushrooms contain antioxidants (Abulude *et al.*, 2004) ^[1]. Mushrooms are rich in carbohydrates, like chitin, hemicellulose, β and α -glucans, mannans, xylans, and galactans, which make them the right choice for prebiotics. Mushrooms act as a prebiotics to stimulate the growth of gut microbiota, conferring health benefits to the host.

Mushrooms are also a good food supplement as they contain minerals and vitamins (Heleno *et al.*, 2010, Mattila *et al.*, 2001) ^[8, 18]. Apart from protein compounds, free amino acids, chitin, amines, nucleic acids and urea can also be found in mushrooms. Mushroom proteins contain all the essential amino acids and are especially rich in lysine and leucine, which are lacking in most staple cereal food. Fresh mushrooms contain relatively large amounts of carbohydrate and further range from 51-88% and 4- 20% mushrooms appear to be a good source of vitamins including thiamine, riboflavin, niacin, biotin and ascorbic acid. Mushrooms also contain all the essential amino-acids required by an adult (Koyyalamudi *et al.*, 2009) ^[11].

3.2 Medicinal Benefits

Mushrooms have long been used for medicinal and food purposes for over a thousand years, but a complete elucidation of the health-promoting properties of mushrooms through regulating gut microbiota has not yet been fully exploited. Mushrooms comprise a vast and yet largely untapped, source of powerful new pharmaceutical substances. Mushrooms have been used in health care for treating simple and common diseases, like skin diseases and pandemic diseases like AIDS. Mushrooms not only contribute in meeting the human food requirement but also have enormous medicinal and pharmaceutical value. Patel and Goyal (2013) ^[19, 20] reported that mushrooms act as anti-cancer compounds play crucial role as reactive oxygen species inducer, mitotic kinase inhibitor, antimitotic, angiogenesis inhibitor, topoisomerase inhibitor, leading to apoptosis, and eventually checking cancer proliferation. Mushrooms are proven to possess anti-allergic, anti-cholesterol, anti-tumor, and anti-cancer properties. Mushrooms possess antioxidant activity, anti-hypertensive activity, hypocholesterolemic activity, liver protection, as well as anti-inflammatory activity, anti-diabetic activity, antiviral activity, and antimicrobial activity (Rai, *et al.*, 2005) ^[22]. More than 100 medicinal functions are produced by mushrooms and fungi and the key medicinal uses are antioxidant, anticancer, antidiabetic, antiallergic, immunomodulating, cardiovascular protector, anticholesterolemic, antiviral, antibacterial, antiparasitic, antifungal, detoxification, and hepatoprotective effects; they also protect against tumor development and inflammatory processes (Yu, *et al.*, 2009; Zhang *et al.*, 2011 and Finimundy, *et al.*, 2012) ^[33]. Mushrooms that contain antioxidants or increase antioxidant enzyme activity may be used to reduce oxidative damage in humans. Medicinal mushroom research has indicated possible cardiovascular, anticancer, antiviral, antibacterial, antiparasitic, anti-inflammatory, hepatoprotective, and antidiabetic activities (Hassan *et al.*, 2011) ^[7]

3.3 Economic Benefits

Mushroom cultivation is a space confined technology and requires marginal investment. It utilizes agricultural residue as substrate for mushroom production. Mushrooms constitute one of the most promising resources for promoting rapid socio economics development (Martinez-ibarra, 2019) ^[15]. Cultivation of mushrooms is a source of national income, as well as means of poverty alleviation. Well as in marketing activities as labor-intensive management and offering opportunities for processing enterprises (Marshall, 2009; Islam *et al.*, 2013) ^[14, 10]. Mushroom farming needs low capital, low technical knowledge and even in an indoor setting it is possible to cultivate mushrooms in their homes like rearing poultry with a little capital (Saker., 2019) ^[24]. Therefore mushroom cultivation not only empowers rural women but also alleviates poverty from the grass root level.

3.4 Environmental Benefits

Mushrooms play an important ecological role In the management of ecosystems (Martinez-ibarra, 2019) ^[15]. Indirect mushroom cultivation is a bioconversion process of organic substances which provides opportunities for the recycling of organic matter thus reducing pollution substances used in mushroom cultivation are applied as organic manures to the land after harvesting of mushrooms. Mushroom cultivation is an appropriate technology for management of agricultural and agro-industrial residues (Chang, 1992) ^[4]. Recently, dumping in landfill and field burning openly were used to dispose of straw which contribute to serious environmental degradation such as global warming; destroying untargeted flora and fauna (Mamiro & Mamiro, 2011), and adversely affecting public health (Das & Mukherjee, 2007)

3.5 Mushrooms Value-Added Products

Mushrooms have a unique flavor with great nutritional value, and are considered by many as an ingredient of gourmet cuisine (Valverde *et al.*, 2015). Fresh mushrooms should be consumed within two to four days of harvesting (Marshall & Nair, 2009; Kumar *et al.*, 2014) ^[14]. Processing into profitable value-added products is an option to reduce the losses due to quality deterioration as well as gaining income and boosting consumption of mushrooms (Kumar *et al.*, 2014). Trending mushroom products available on markets are snacks, fried mushrooms, burger, pastry, nuggets, popcorn, pickles, biscuit, ketch-up, soup powder and candy (Kumar *et al.*, 2014). For Malay cuisine, it can include floss (serunding), in curry meals and used also as satay (Mohd Tarmizi *et al.*, 2013).

4. Challenges of mushroom production in India

Mushroom cultivation has proven to be one of the most remunerative enterprises but its adoption among the farmers has not found up to the mark due to certain constraints. Researcher revealed that non-availability of raw materials particularly spawn and compost, complicated loan procedure, lack of government initiative, lack of awareness about nutritive value, lack of adequate technical guidance, irregular fluctuating production, perishable nature, lack of knowledge about improved cultivation technology, lack of transport to the nearest town, lengthy and cumbersome method of compost preparation, limited post-harvest processing options and lack of regulated market were some of the main constraints in adoption of mushroom as an enterprise. The most important hurdle in mushroom production is that it is

highly perishable, which needs quick disposal. Singh *et al.* (2008) ^[28, 29] reported that lack of cold storage and non-availability of quality of spawn and high wage rate of labor were the important constraints. Gautam *et al.* (2014) ^[6], who reported that the main constraint faced by the mushroom growers was lack of support for mushroom entrepreneurs from the government side and also there was lack of government schemes for mushroom production. Shirur *et al.* (2016) ^[27] who found that lack of technical information and exploitation by consultants were some of the major constraints faced by respondents. Sharma and Kanbid (1994) ^[26] also reported that no provision for sale of fruit in the local or nearby market, lack of transportation facilities, lack of storage facilities and no provision for remunerative prices for good quality produce were some of the main marketing constraints faced by the farmers. Lack of proper marketing channels was a major constraint in adoption of mushroom production enterprises (Goutam *et al.*, 2014 and Kumari *et al.*, 2018) ^[6, 12]. Fluctuating prices prevailing in the market were the major marketing constraints (Singh *et al.*, 2008) ^[28, 29]. Lack of cold storage facilities was the major constraint in storage constraints (Singh *et al.*, 2008) ^[28, 29]. Lack of a government scheme for mushroom production was a major economic constraint (Kumari *et al.*, 2018) ^[12]. Researchers have revealed that non availability of spawn, lack of well-organized markets, poor knowledge about financial assistance, news on mushroom poisoning and inadequate knowledge about mushroom preservation and recipes of mushroom items are the major constraints towards a sustainable mushroom industry (Majumder *et al.*, 2009 and Sharma *et al.*, 2016) ^[13, 25].

5. Conclusion

This study concluded that mushrooms are used not only as a source of nutrients, but also as medicinal resources. Polysaccharides from mushrooms were reported to exhibit immunomodulation properties, antitumour, antioxidant, antimicrobial and prebiotic activity due to the greatest potential for structural variability in comparison with other biological active molecules. The benefits of mushrooms are relatively economical because the mushrooms can be grown on a number of inexpensive agricultural or forest wastes such as rice straw, corn cobs and saw dust. In the quest for economical and ecologically sound methods for environmental remediation, the use of mushrooms is a very good approach and solution. Despite many benefits there are some constraints in mushroom production that are followed by input constraints, technological constraints, general constraints, socio-cultural constraints and crop management constraints. Management from 'waste-to-wealth' is essential for more sustainable farming globally, and increasing mushroom production in India seems a viable and attractive option. Boosting the commercial value of products whether in a fresh or processed form could increase concentration of demand and encourage market orientation.

6. References

1. Abulude FO, Adeyeye EI, Asaolu SS. Metal levels in mushrooms consumed in southern Nigeria. *Advances in Food Science*. 2004;26:155-158.
2. Aremu MO, Basuk, Gyan SD, Goyal A, Bhowmik PK, Datta Banik S. Proximate composition and functional properties of mushroom flours from *Ganoderma* spp, *Omphalotus olearius* (DC) sing and *Hebeloma*

3. *mesphaeum* (Pers) Quels used in Nasarawa State, Nigeria. *Mal of Journal Nutrition*. 2009;15(2):233-241.
4. Atkins FC. *Minor disease and competitors: mushroom growing today*. Faber and Faber Ltd, 3 Queen Square, London, 1972, 188.
5. Chang ST, Miles PG. *Mushroom biology - A new discipline Mycologist*. 1992;6(2):64-65.
6. Chang R. *Functional properties of edible mushrooms*. *Nutrition Reviews*. 2012;54:91-93.
7. Gautam Ashok Kumar *et al.* Constraints in adoption of mushroom production enterprise. *Indian Journal of Extension Education*. 2014;5(1, 2):39-41.
8. Hassan LG. Evaluation of nutrient and anti-nutrient contents of *Parkia biglobosa* (L.) flower. *Nigerian Journal of Basic and Applied Science*. 2011;19:76-80.
9. Heleno SA, Barros L, Sousa MJ, Martins A, Ferreira IC, FR. Tocopherol composition of Portuguese wild mushrooms with antioxidant capacity. *Food Chemistry*. 2010;119(4):1443-1450.
10. Hobbs C. *Medicinal mushrooms. an exploration of tradition, healing and culture*, Botanica Press, 10226, Empire Grade, Santa Cruz, CA, 1995, 95060.
11. Islam MK, Khan MMH, Islam MN. An unrealized manner for poverty alleviation. *The Mushroom Industry Dhaka University Journal of Marketing*. 2013;16(1):43-56.
12. Koyyalamudi SR, Jeong SC, Song CH, Cho KY, Pang G. Vitamin D2 for nation and bioavailability from *Agaricus bisporus* button mushrooms treated with ultraviolet irradiation. *Journal of Agriculture and Food Chemistry*. 2009;57(8):3351-5. Doi:10.1021/JF803908q
13. Kumari AR, Singh DP, Singh A, Laxmikant, Kumari M. Adoption level and Constraints in Scientific Mushroom Cultivation among Rural Women. *International Journal of Current Microbiology and Applied Sciences* 2018;7:1280-1287.
14. Majumder D, Das PK, Gogoi R. Adoption of recommended mushroom production technology and strategies for developing mushroom industry in Assam. *Mushroom Research*. 2009;18(2):83-90.
15. Marshall E, Nair NG. *Make money by growing mushrooms* Food and Agriculture Organization of the United Nations (FAO) Rome. 2009.
16. Martinez-Ibarra E, Gomez- Martin MB, Armesto-Lopez XA. Climatic and socioeconomic aspects of mushrooms. The case of Spain Sustainability. 2019;11(4):10-30.
17. Mhanda FN, Kadhila-Mwandingi NP, Ueitele ISE. Minerals and trace elements in domesticated Namibian *Ganoderma* species. *African journal of biotechnology*. 2015;14:3216-3218.
18. Miah MN, Begum A, Shelly NJ, Bhattacharjya DK, Paul RK, Kabir MH. Effect of different sawdust substrates on the growth yield and proximate composition of white oyster mushroom (*Pleurotus ostreatus*). *Bioresearch Communications*. 2017;3(2):397-410.
19. Mattila P, Conk KO, Eurola M *et al.* Contents of vitamins, mineral elements, and some phenolic compounds in cultivated mushrooms. *Journal of Agricultural and Food Chemistry*. 2001;49(5):2343-2348.
20. Patel S, Goyal A. Recent developments in mushrooms as anti-cancer therapeutics. *Journal of Biotechnology*. 2013;2:1-15.
21. Patel S, Goyal A. Recent developments in mushrooms as anti-cancer therapeutics. *Journal of Biotechnology*.

2013;2:1-15

21. Rahman M. Problems and prospects of quality mushroom supply for the domestic market. M. Sc. Thesis Department of agribusiness and Marketing, Sher-e-Bangla Agricultural University Dhaka, 2018.
22. Rai M, Tidke G, Wasser SP. Therapeutic potential of mushrooms. *Natural product radiance*. 2005;4:246-257.
23. Yu S, Weaver V, Martin K, Cantorna MT. The effects of whole mushrooms during inflammation. *BMC Immunology*. 2013;10(12).
24. Sarker NC. Mushroom A promising crop for Bangladesh (Accessed 02 January, 2020) Available <https://dailyasianage.com/news/2019/11/18/61/mushroom-a-promising-crop-for-bangladesh>. 2019.
25. Sharma D, Kumar A, Guleria JS. Economic viability, technological gap and problems of mushroom cultivation in Mandi district of Himachal Pradesh. *Himachal Journal of Agricultural Research* 2016;42(1):47-54.
26. Sharma DD, Kanbid BR. Adoption Constraint of Scientific Horticultural Technology. *Indian Journal of Extension Education*. 1994;4:119-122.
27. Shirur Mahantesh *et al.* Technological adoption and constraint analysis of mushroom entrepreneurship in Karnataka. *Economic Affairs*. 2016;61(3):427-436
28. Singh Nasib *et al.* Constraints in mushroom production technology in Haryana. *Agricultural Science Digest*. 2008;28(2):118-120.
29. Singh N, Mehta S, Godara AK, Yadav VP. Constraints in mushroom production technology in Haryana. *Agricultural Science Digest*. 2008;28(2):118-120.
30. Singh S, Makhija VK, Godara A, Nanwal RK. Socio-economic status of mushroom growers in Haryana. *Haryana Agriculture University Journal Research* 2003;32(2):149-151.
31. Singh SS, Wang H, Chan YS, Pan W, Dan X, Yin CM *et al.* Lectins from edible mushrooms. *Molecules* 2014;20:446-469.
32. Finimundy TC, Gambato G, Fontana R *et al.*, Aqueous extracts of *Lentinula edodes* and *Pleurotus sajor-caju* exhibit high antioxidant capability and promising in vitro antitumor activity. *Nutrition Research*. 2009;33(1):76-84.
33. Zhang L, Fan C, Liu S, Zang Z, Jiao L. Chemical composition and antitumor activity of polysaccharide from *Inonotus obliquus*. *Journal of Medicinal Plants Research*. 2011;5(7):1251-1260.