

Evaluation of Mushrooms Broth Cube and Its Compared With Maggi Broth Cube Products in Saudi Arabia

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Abstract: Mushrooms were formerly called "meat of poverty" in center Europe because the composition of mushroom proteins is higher nutrition value than of most plant protein. Therefore, mushroom broth stock was prepared and it compared with Maggi cube products (vegetable, chicken and beef) then evaluated from chemically analysis, sensory evaluations and microorganisms were estimated. The results from Maggi cubes (chickens, beef and vegetables) products and mushrooms broth cube showed that the chemical compositions of chicken cube was the highest protein content (8.6%) followed by mushrooms broth cube (7.9%) and beef cube (6.9%), whereas the vegetable was the lowest protein content (4.8%). Crude fat, total fiber and ash were found ranging between 2.9 to 4.7%, 25.9 to 38.1% and 19.6 to 30.8% dry matter, respectively. The sensory evaluation results from the mushroom broth cube and Maggi cubes (vegetables, chicken and beef) products were no significant differences among of the soup samples in color/appearance, taste, mouth feel, flavor, consistency and overall acceptability. However, the mushroom soup is the most acceptable of all the traditional soups. Biological activity as total bacteria and fungi count were estimated in mushroom broth cube and maggi cubes (vegetables, chicken and beef) products and the results are showed that the total count bacteria and fungi were obtained no variation in the total count bacteria (3.06 to 3.59×10^{-6} CFU) and fungi (1.01 to 1.54×10^{-2} CFU) respectively. The mushroom and Maggi cubes (vegetables, chicken and beef) products on vegetative growth and aflatoxin production by *Aspergillus flavus* in liquid media were studied. The various mushroom and maggi cubes (vegetables, chicken and beef) extracts supported good vegetative growth of *A. flavus* and the results showed that the best growth was obtained from mushroom cubes (216.67 mg) followed by Maggi vegetable cubes (176.67 mg), the least growth was observed for beef cubes (96.67 mg). The aflatoxins B1, B2 G1, and G2 were not formed in the mushroom and Maggi cubes (vegetables, chicken and beef) products. It may be recommended that the mushroom and Maggi cubes (vegetable, chicken and beef) products are acceptability and safety soup from any resident microorganisms and aflatoxins. Therefore, mushroom broth cube is improved stability of products and safety to consume as good food sources.

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1.Introduction

Food additives are any substance that become part of a food product or that otherwise affect the characteristics of any food, directly or indirectly through producing, processing, treating, packaging, transporting, or storing. Some 2,800 substances are intentionally added to foods, whereas 10,000 other compounds find their way into the foods during processing, packaging or storage (Nieman *et al.*, 1992).

Food spices (additives) are widely used these days as flavor enhancers. Sweeteners, leavening agents, nutrients etc. In Nigeria different spices are formal / used by different tribes. These spices have nutritional relevance and healing potentials (Ekpo and Jimmy, 2005). Solomon (2006) has reported in local spices, they concluded that these spices give humans some level of stimulation in the activity of the digestive tract. Adeyeye *et al.*(2002) reported a natural food condiment (African locust bean) seeds as the most

important natural food condiment in the entire savannah region of west and central Africa.

Meat is any flesh of an animal that is used for food. It is nutritious and highly attractive in appearance. There are various meat types; they have different chemical compositions (Soniran and Okubanjo, 2002). Before consumption meats are cooked when cooked they tend to change color, produce juices and texture changes. The time of cooking depends on the meat spices and so many other factors (McClenahan and Driskell, 2002). The purpose of this study was to determine the effects of different local additives (garlic, ginger, pole, megnut, maggi cube, ohiha, oziza and locust bean) sensory properties of meat (beef, goat and broiler) samples.

The bouillon cube or "Maggi cube", which was another meat substitute product, was introduced in 1908. Because chicken and beef broths are so common in the cuisines of many different countries, the company's products have a large worldwide market. In West Africa and parts of the Middle East, Maggi cubes

are used as part of the local cuisine. Throughout Latin America, Maggi products, especially bouillon cubes, are widely sold with some repackaging to reflect local terminology. In the German, Dutch had come to be known as "Maggi herb" because it tastes similar to Maggi sauce. Bouillon cubes are taste enhancers and are added to foods to augment the taste properties of food (Akpanyung, 2005). The major active ingredients in bouillon cubes are salt (NaCl) and monosodium glutamate (MSG). Other raw material used include soybeans, locust beans, onion, tomato, hydrogenated palm oil (HPO), caramel, hydrolyzed plant/ vegetable protein and natural spices (RMRDC, 2003). Oxidative and hydrolytic degradation products of the lipid components of bouillon cubes indicates that the fats blended into the bouillon cube preparation were highly variable and were mainly made up of refined vegetable oils that had undergone hardening by hydrogenation in most cases (Caponio *et al.*, 2002 and 2003).

Mushrooms consist of two main parts, the mycelium and the fruitlet (sporocarp). The mycelium consists of a treelike structure called hyphae hidden in the soil. The mycelium absorbs food nutrients while the hyphae form into mycelia which forms the fruit (sporocarp) structure on the surface when atmospheric conditions particularly humidity is favorable. The spore producing tissue is called the hymenium (Etang *et al.*, 2006). Mushrooms vary in sizes, color, texture and structure that favor their spore formation. The cap is called the cuticle and varies among different mushroom species, being sticky or slimy in texture. The stalk is the stem-like structure on which the cap is mounted and this varies in length depending on the species (Gyar and Ogbonna, 2006).

Colak *et al.* (2009) investigated the protein, crude fat and carbohydrate contents (limit values%: average) of mushroom samples were found to be 21.12-50.10:34.08, 1.40-10.58:6.34 and 34-70:55%, respectively. The zinc, manganese, iron and copper contents of the mushrooms samples were found to be in the range of 47.00-370.00 mg/kg, 7.10-143.00 mg/kg, 30.20-550.00 mg/kg and 15.20-330.00 mg/kg, respectively.

The consumption of wild edible mushrooms is increasing due to a good content of proteins and trace minerals. Mushrooms are valuable healthy foods, low in calories, fats, and essential fatty acids, and high in vegetable proteins, vitamins and minerals Agrahar-Murugkar and Subbulakshmi (2005).

The microbiological contamination of spices may arise from sources, such as indigenous microflora of plants, microorganisms present in processing plant, air, post harvest contamination from dust, use of contaminated water and from human contact, (Wirtanen and Sjoberg, 1993). During cleaning and processing, there is progressive reduction in the

number and types of microorganisms; those remaining are usually aerobic spore-forming bacteria and common moulds (Guarino and Peppler, 1973). In addition to the contamination of raw food supplies that occurs during growing, shipping and processing, there is the problem of food contamination caused by people who are carriers of pathogens such as *Salmonella*, *Escherichia coli* and *Staphylococcus aureus*. Even though few food borne outbreaks have been traced to the consumption of contaminated spices, numerous isolations of pathogens, from a variety of spices, including oregano, black pepper and white pepper (whole and in powder form) have been reported (Wilson and Andrew, 1976).

The aim of the present study was to substitute the animal protein and poor vegetable protein in Maggi cubes with high vegetarian protein from mushrooms. The chemical compositions, sensory properties and biological activity as a total count bacteria and fungi and also aflatoxin analysis were determined in Maggi cubes (chickens, beef and vegetables) from local market and compared with mushrooms broth cube as a new bouillon cube.

2. Material and Methods

Material:

Three different brands of bouillon or Maggi cubes (chicken, beef and vegetable) products were purchased from local market in the King of Saudi Arabia.

Mushrooms (*Agaricus bisporus*) sample (without division into pileus and stipe) was purchased from local market in the King of Saudi Arabia. Fresh sample, after removal of external material by washing with dematerialized water, were air dried between filter papers (Colak *et al.*, 2007). After that the mushrooms sample was soaked in citric acid 2% for five minutes and dry in an electric oven at 55±5 °C for 18 hours.

Twenty cubes of each bouillon samples and 100g dry mushrooms sample after treatment were ground into powder using a food blender and transferred into poly ethylene bags. The bags were stored in a desiccators containing calcium chloride to keep the samples dry.

Methods:

Preparation of mushrooms broth cube:

Mushrooms broth cube was mixed from dry powder mushroom 7.42 g, spice crushed (turmeric 0.5g, white pepper 0.2g and fenugreek 0.1g), dry celery leaves powder 0.45g, dry parsley leaves powder 0.24g, dry thyme leaves powder 0.01g, dry onion powder 2.25g, dry garlic powder 1.0g, corn starch 8.0 g, yeast 0.2g, sodium mono glutamate 12.65, vegetable fat 7.16g, glucose 28.0g and salt 32.0g. The ingredients were mixed well and it was in the form of cubes coated with aluminum foil according to (Patent no., 2968 to 9/17/2012 in Saudi Arabia).

Chemical analysis:

Chemical composition of the three different brads of bouillon or Maggi cubes (chickens, beef and vegetable) products and mushrooms broth cube were determined as a moisture, by drying in a moisture determination apparatus (Precisa HA60) at 110 °C until circulation was completed; ash, from the incinerated residue obtained at 550°C after 3 hrs; crude protein, by the Kjeldahl method with a conversion factor of 6.25 and total fiber were determined according to (Güner *et al.*, 1998 and AOAC, 2000); crude fat, gravimetrically determined after Soxhlet extraction with petroleum ether (Sanmee *et al.*, 2003 and Colak *et al.*, 2007). The total carbohydrate was calculated as 100% - (% crude fiber+ % ash+ % crude protein+ % fat) (Mattila *et al.*, 2002 and Colak *et al.*, 2007). Total energy values were calculated by multiplying the amounts of protein and carbohydrate by the factor of 4 kcal/g and lipid by the factor of 9 kcal/g (Italian law, 1993).

Sensory Evaluation:

The three traditional broth Maggi cubes (chicken, beef and vegetable) products and mushroom broth cube were subjected to sensory evaluation to determine their acceptability. The soups were cooled and presented to a 15-member panel familiar with the products. The soups were evaluated for attributes of color/appearance, taste, mouth-feel, flavor, aroma, consistency and overall acceptability (Larmond, 1977).

Determination of microbiological analysis:

Biological activity as total count of bacteria and fungi were estimated by the plate methods of Allen (1959) and Martin (1950) in the three traditional broth Maggi cubes (chicken, beef and vegetable) products and mushroom broth cube during storage at room temperature for four weeks. Plates of biological activity were incubated in incubator at 30 °C for three days.

Aflatoxigenic potential of *Aspergillus flavus* isolated from the spices soup:

Thirty milliliters of the spices soup (Maggi chicken, Maggi beef, Maggi vegetable and mushroom broth cubes) were inoculated with 1 ml spore suspension of *A. flavus* (about 1.0×10^4 cfu/g). The Erlenmeyer flasks were incubated for 5 days at 30°C.

Growth in the liquid medium was assessed by estimating the dry weight of the harvested mycelium. Mycelium collected on a previously weighed and dried with filter paper at 75°C for 24 h and then reweighed after cooling in desiccators.

Determination of Aflatoxin levels in the spices:

This was determined using the high performance liquid chromatography (HPLC) Equipment, following the method outlined by Pons (1979). The culture filtrate of *A. flavus* from each of the spices (Maggi chicken, Maggi beef, Maggi vegetable and mushroom broth cubes) were subjected to aflatoxin determination.

Statistical analysis:

The data obtained were analyzed by using SPSS statistical software (version 13 SPSS Inc., Chicago, USA). The results were expressed as mean \pm SD. Tested for significance using one-way analysis of variance "ANOVA" according to (Armitage and Berry, 1987).

3. Results and Discussion**Chemical compositions:**

The results obtained from proximate chemical analysis of the Maggi cubes (vegetable, chicken and beef) products and mushroom broth are presented in Table (1). The results showed that the crude protein content of the chicken cube was the highest (8.6%) followed by mushrooms broth cube (7.9%) and beef cube (6.9%), whereas the vegetable cube was the lowest protein content (4.8%).

Colak *et al.* (2009) investigated that the mushrooms are rich sources of protein and carbohydrates and had low amounts of fat. Metal contents and energy values of the studied mushrooms were nearly similar to each other and agreed-well with the previous data. The results make these wild edible mushrooms popular to consume as good food sources.

Crude fat and fiber in Maggi cubes (vegetable, chicken and beef) products and mushroom broth were found to be fairly high ranging between 2.9 to 4.7% and 25.9 to 38.1%, respectively. Ash is a reflection of the total inorganic matter present in a good sample and it was ranged from 19.6 to 30.8% dry matter.

Table (1): chemical composition of three traditional Maggi cubes and mushroom broth cube on dry weight basis g/100g

Chemical analysis	Mushroom cube	Vegetable cube	Chicken cube	Beef cube
Crude protein	7.9	4.8	8.6	6.9
Crude fate	3.8	2.9	4.7	3.5
Total fiber	30.7	38.1	25.9	27.5
Crude ash	22.5	30.8	19.6	21.9
Total carbohydrates	35.1	23.4	41.2	40.2
Energy value Kcal/100g	184.8	138.9	241.5	219.9

Sensory characteristics:

The sensory evaluation results from Table (2) revealed that the mushroom broth cube and Maggi cubes (vegetables, chicken and beef) products were no significant differences among of the soup samples in color/appearance, taste, mouth feel, flavor, consistency and overall acceptability. The highest mean score obtained for chicken soup (90%) followed by mushroom soup (88%), beef soup (86%) and vegetable soup was rated significantly decrease (84%) in color/appearance, taste, mouth-feel, flavor, consistency and overall acceptability. The highest scores of chicken and mushroom soups may be able to due probably to the high fat and protein, compared to other soups. The relatively lower mean scores of the beef and vegetable soups are probably due to the fact that it is not as popular as the chicken soup. All the soups were still acceptable to the panelists as indicated by their mean score for overall acceptability. However, the mushroom soup is the most acceptable of all the traditional soups.

Soup is defined as a liquid food, usually savory, made by stewing ingredients such as meat, vegetables, fish or game, often in a stock and with seasoning (**The New Webster's Dictionary, 1995**).

Maggi cubes are taste enhancers when added to foods. The major ingredient is salt (Na Cl), monosodium glutamate (MSG), vegetable oil, starch and spices. MSG is a flavor enhance, classified under general recognized as safe (GRAS) by the US food and Drug Administration (**Akpanyung, 2005**). The release of more flavor components due to increased fat solubilization may have contributed to improved meat sample's flavor. Increase in meat flavor is caused by a greater activity of the Millard reaction and associated reacting in valuing muscle protein, carbohydrates and lipids and their degradation products (**Ekanem and Solomon, 1997**).

Spices are known to enhance and improve the flavor and color of foods (**Ekanem and Achirnewhu, 1998**). They vary in their effects in that the aroma and flavor principles in spices are based on the essential contained in them. It would be assumed that the oils present in magi cube and some of the spices may have produced some modification of the flavor, taste and color thus making the meat samples generally accepted by the panelists.

Table (2): Sensory means scores of traditional broth cubes and mushroom broth cube

Attribute	Mushroom cube	Vegetable cube	Chicken cube	Beef cube
Color/appearances	18 ^a ±1.06	16 ^c ±0.79	18 ^a ±0.93	16 ^c ±0.73
Taste	17 ^b ±0.56	17 ^b ±0.72	18 ^a ±0.77	17 ^b ±0.59
Mouthfeel	18 ^b ±0.21	17 ^b ±0.65	18 ^a ±0.68	18 ^a ±0.64
Flavor	17 ^b ±0.23	17 ^b ±0.35	18 ^a ±0.58	17 ^b ±0.82
Consistency	18 ^a ±0.67	17 ^b ±0.74	18 ^a ±0.81	18 ^a ±0.76
Overall acceptability	88	84	90	86

Microbiological analysis:

Biological activity as total bacteria and fungi count were estimated in mushroom broth cube and Maggi cubes (vegetable, chicken and beef) products and the results are reported in Table (3). The results from table (3) showed that the total count bacteria and fungi were obtained no variation in the total count bacteria (3.06 to 3.59×10^6 CFU) and fungi (1.01 to 1.54×10^2 CFU) respectively.

To ensure effective food safety management in Africa, tolerance levels of mycotoxins and bacteria should include measures to control mycotoxins formation through good agricultural practices, proper storage and handling methods (**Odamtten, 2005**). Food safety control measures should also be used at each stage in the production chain as prescribed by the hazard analysis critical control point (HACCP) concept. Other strategies such as the use of appropriate processing techniques, simple cleaning and segregation procedures could help reduce levels of contamination of foods for human consumption. The highest priority however, needs to be placed on creating consumer awareness and adequate education for producers of agricultural produce (**IAEA, 2004**).

Even after using HACCP to select samples for storage, samples may be predisposed to varying environmental humidities that are unsafe. It is therefore expedient to eliminate microorganisms using methods other than chemical applications. Chemical applications are now banned in many countries. Gamma irradiation of food has been proposed and is being used in 26 countries worldwide to curtail the resident microorganisms in foods and thus extend the shelf- life of many agricultural products (**IAEA, 2004**). The recommendation by the joint FAO/IAEA/WHO experts committee of food Irradiation accepted in 1980, as safe for human consumption, products treated with an overall gamma irradiation dose of 10 KGy. Irradiation of spices improved stability of products and goods produced from them (**IAEA, 2004**).

Table (3): Microbiological activity of different broth cubes

Broth cubes	Total bacteria count $\times 10^6$ CFU	Total fungi count $\times 10^2$ CFU
Mushroom cube	3.06	1.11
Vegetable cube	3.30	1.54
Chicken cube	3.55	1.01
Beef cube	3.59	1.31

Aflatoxin analysis of Maggi samples and mushrooms broth cube:

Influence of the mushroom and Maggi cubes (vegetable, chicken and beef) products on vegetative growth and aflatoxin production by *Aspergillus flavus* in liquid media were studied. The various mushroom and Maggi cubes (vegetable, chicken and beef) soups supported good vegetative growth of *A. flavus* and the results are reported in Table (4). From the results in Table (4) it could be noticed that the mushroom and Maggi cubes (vegetables, chicken and beef) products variably supported vegetative growth of *A. flavus*. The best growth was obtained from mushroom cubes (216.67 mg) followed by Maggi vegetable cubes (176.67 mg), the least growth was observed for beef cubes (96.67 mg).

The results from analysis for aflatoxins in Table (4) showed that the aflatoxins B₁, B₂, G₁, and G₂ were not formed. Presumably, the mushroom and Maggi cubes (vegetables, chicken and beef) products were stable and their formulation and preservatives, offered self-protection against aflatoxins formation by *A. flavus* especially, in mushroom and Maggi cubes which might have produced conditions unfavorable for aflatoxins formation.

Aflatoxins are immunosuppressive, mutagenic, teratogenic and carcinogenic in their effect with the main target organ being the liver. Evaluation of epidemiological and laboratory results carried out in 1987 by the international agency for research on cancer (IARC, 1987) found that there is sufficient evidence in humans for carcinogenicity of naturally occurring mixtures of aflatoxins. The aflatoxins are therefore classified as Group I carcinogens. A recent review showed that the danger of aflatoxicoses cases still exists in Africa (Odamtten, 2005).

Table (4): Aflatoxin analysis of Maggi samples and mushrooms broth cube after growth of *Aspergillus flavus* for 5 days at 30°C using HPLC technique.

Broth cubes	Aflatoxins($\mu\text{g}/\text{kg}$)				Dry weight of mycelium (mg)
	B ₁	B ₂	G ₁	G ₂	
Mushroom cube	ND	ND	ND	ND	216.67
Maggi Vegetable	ND	ND	ND	ND	176.67
Maggi chicken	ND	ND	ND	ND	136.67
Maggi Beef	ND	ND	ND	ND	96.67

Detection limit: Aflatoxin B₁ and B₂ = 0.04 $\mu\text{g}/\text{kg}$, Aflatoxin G₁ and G₂ = 0.06 $\mu\text{g}/\text{kg}$,
ND: not detected.

From the above results it may be recommended that the mushroom broth cube is a good source of protein and fat compared with maggi cubes. Mushroom and Maggi cubes (vegetables, chicken and beef) products are acceptability, safety soup and without any resident microorganisms and aflatoxins. Therefore, mushroom broth cube is improved stability product and safety to consumer and as a good nutrient source.

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