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CONSUMPTION OF EDIBLE MUSHROOMS IN DEVELOPING COUNTRIES: THE CASE OF MEXICO

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ABSTRACT

Major efforts in mushroom cultivation have been focused on technological developments and yields. However, its future will also depend on a thorough understanding of consumer trends worldwide. This is the case of developing countries where the importance of edible mushrooms within consumer preferences and perceptions is not yet clear and studied. We carried out a study (2000-2003) to understand the patterns of mushroom consumption in central Mexico, where most wild/cultivated mushrooms are produced and/or marketed. Structured interviews were made to urban consumers, and data were statistically analyzed by the correlation of variables studied. About half (49.4%) of urban consumers buy mushrooms, independently of their social level (fresh or canned: *Agaricus*, *Pleurotus*, *Lentinula*). There were differing factors affecting mushroom quality and price through long channels of distribution. Preferences and perceptions from Mexican consumers depended on the social level. Mushroom prices were considered very or regularly expensive which is correlated with historical records, as the minimum wage decreased during 1940-2002 (63.9%). Consumer prices of mushrooms are higher than foods widely consumed. The annual variation of mushroom prices between cities, regions, and places of purchase, is high affecting consumption. A national strategy to increase mushroom consumption is discussed considering social levels and regions.

INTRODUCTION

During the last decades, major efforts in the cultivation of edible mushrooms have been focused on technological developments and yields (Flegg *et al.*, 1985; Elliott, 1995; Royse, 1996; Martínez-Carrera, 1998; Van Griensven, 2000; Oei *et al.*, 2003). This approach has lead to a significant increase in the world production of edible mushrooms, which has been estimated in about 4,909,300 metric tonnes (Chang, 1999). However, in a globalized world, the future of mushroom cultivation will also depend on a thorough understanding of the consumer trends worldwide. This is particularly the case of developing countries where mushroom production is at the beginning, and the importance of edible mushrooms within consumer preferences and perceptions is not yet clear.

Growers' associations from Australia, Canada, U.S.A., and several European countries have developed statistics on mushroom production, as well as surveys on consumer demands, and have promoted successful marketing strategies (Berendse, 1984; Potter, 1993; Phelps and Greenan, 1996). In Mexico, the cultivation of edible mushrooms has been developing during 70 years since 1933, on a large and small (rural) scale (Martínez-Carrera *et al*., 1991a, 1991b, 1998, 2002; Martínez-Carrera, 2000). At present, the commercial mushroom production has been estimated to be 38,708 tonnes per year, including the champignon (*Agaricus*: 94.3%), oyster mushrooms (*Pleurotus*: 5.6%), and shiitake (*Lentinula*: 0.1%). Its economic value reached around 100 million dollars in 2002, and there are already about 20,000 workers devoted directly or indirectly to this activity (Martínez-Carrera, 2002). Despite of the social, economical, and ecological importance of commercial mushroom production in Mexico, several aspects are virtually unattended: 1) Organization of growers (large, small); 2) Analysis of the channels of distribution; 3) Integral marketing strategies; and 4) Studies on the consumer needs. This has made difficult to carry out

an overall strategic planning for the development of the mushroom industry in a national and global context, as actual production data, domestic consumption, imports, and exports are difficult to follow (Martínez-Carrera *et al.*, 1992, 2000; Martínez-Carrera, 2002). Furthermore, the urban population in Mexico increased from 35.1% in 1940 (6.8 million people) to 74.6% in 2000 (72.7 million people) [INEGI, 2000]. Most wild and cultivated mushrooms are gathered, produced and/or marketed in the central region, where urbanization has been developing steadily and there is tradition for mushroom consumption. We carried out research work at different levels of the chain production-consumption within this region, particularly focused on urban consumers. This allowed to understand the patterns of mushroom consumption, and provided fundamental information to develop suitable strategies for making mushroom attributes available to all possible consumers.

METHODOLOGY

Region of study

The States of Mexico, Puebla, and Tlaxcala, located in the central region of Mexico, were selected for this study during 2000-2003 (Fig. 1). Studies were carried out in the cities of Mexico (8.6 million people), Puebla (1.3 million people), and Tlaxcala (0.073 million people), where there is a wide diversity of mushroom sources and products available to the consumer and there is also a broad consumer diversity as a result of rural migration from differing regions of the country (INEGI, 2000, 2001).

Fig. 1. The central region of Mexico studied in this work, where most wild and cultivated mushrooms are gathered, produced and/or marketed.

The chain production-consumption

Interviews were made to people for assessing the proportion of mushroom consumers (540), as well as those people involved at different levels of this chain: growers [large (2), small (9)], retailers (11), restaurants (23), "tacos" outdoor stands (39), and consumers [public markets (241), "tianguis (popular market days)" (58), and gastronomic fairs (102)]. Supermarkets did not allow interviews, and accordingly only prices, as well as advertising/popularizing at the point of sale, were studied in these places.

Structured interviews at the point of sale

Main variables studied were: prices; incomes; consumption preferences (what, how, when, and where mushrooms are consumed); and consumption perceptions (mushroom quality, flavour, appearance,

nutritional and medicinal value). Interview protocols for the groups of people involved in this study were developed, having series of variables studied within short-answer items, as well as items with adjectival and adverb responses. Appropriate measurement scales were assigned to each variable. The interview protocol was applied individually by formal interviews, followed by an observation protocol. A set of interviews (540) were applied to study the proportion of mushroom consumers within the population, while other sets (485) were applied to different levels of the chain production-consumption in order to know about variables studied. Cities were studied according to probability sampling (95%) in infinite population (Zikmund, 1998). Consumers were interviewed by simple random sampling, and grouped into low, medium, and high social level, according to their characteristics and additional criteria from the Bank of Mexico (http://banxico.org).

Databases

National and international official databases on social aspects and mushroom prices recorded were analyzed. In Mexico, fundamental databases were: 1) INEGI (National Institute of Statistics, Geography and Informatics; Secretary of Finance and Public Credit; http://inegi.gob.mx) through the national survey of household incomes and expenses carried out every two years; 2) The Bank of Mexico (http://banxico.org) through the consumer price index (INPC-Mexico) recorded biweekly; and 3) CONASAMI (National Commission of Minimum Wages; Secretary of Labour and Social Prevision; http://conasami.gov.mx) through the minimum wages recorded yearly. Other secondary databases were also analyzed. In order to compare the evolution of the purchasing power from different years (1940-2002), minimum wages (MW) were subjected to deflation according to Wonnacott and Wonnacott (1984). Mushroom and food prices were also subjected to deflation using the same methodology.

Statistical analysis

Data were statistically analyzed by the correlation of variables studied in order to understand the main patterns followed by consumers. Correlation of variables amongst social groups were performed according to the non-parametric test of Kruskal-Wallis through the SPSS software (Berenson and Levine, 1991).

RESULTS

Profile of people interviewed

Man (40.3%) and women (59.7%) from all social levels were interviewed, having a wide range of age (16-80 years old), education (not formal education, primary school, secondary school, high school, bachelor level, postgraduate level), occupations (house wife, student, trader, professional, worker, free lance), and family size. Data from household facilities indicated that most people interviewed have good potential: 1) To assimilate the media messages on edible mushrooms (96.0%); 2) To be informed about mushroom storage at home (93.1%); and 3) To provide basic information for surveys on trends of mushroom consumers. Consumers interviewed were representative of each social level in the region (low: 29.9%; medium: 41.4%; high: 28.7%).

Proportion of mushroom consumers within the population

Interviews showed that about half (49.4%) of urban consumers do buy mushrooms, independently of their social level (Table 1). The other half (50.6%) do not buy them for a number of reasons, such as feelings of not liking (75.5%), unawareness (18.3%), or various perceptions (6.2%; harmfulness, uncleanness, unavailability, ignorance of cooking ways).

Table 1. Proportion of mushroom consumers in the region studied, according to interviews (n= 540) carried out at public markets and places, as well as "tianguis" (popular market days).

Social level	Age (frequency)	City (Percentage from the total)	Mushroom consumption (%)	
			Consumer	Non consumer
Low	20-40 (59) 41-60 (42) > 60 (4)		46.7	53.3
Medium	20-40 (200) 41-60 (60) >60 (1)		49.8	50.2
High	20-40 (134) 41-60 (39) >60 (1)		50.6	49.4
Total			49.4	50.6
		Mexico	48.4	51.6
		Puebla	47.1	52.9
		Tlaxcala	56.5	43.5

Patterns of mushroom production and consumption

Growers

Mexican mushroom growers were very heterogeneous in terms of species cultivated, preferences, perceptions of the mushroom quality and price, and local market management. In general, mushroom yields decrease during local autumn and winter time, when mushroom prices are also higher. Large mushroom growers are producing mushrooms (*Agaricus*, *Pleurotus*, *Lentinula*) commercially for more than 11 years (diverse product lines: fresh, fresh and packed, canned), including the processing of wild mushrooms [*e.g.*, "cuitlacoche", *Ustilago maydis*]. When market prices are very low, mushrooms may be intentionally discarded by growers to recover their competitive value. Perceptions of these growers included that: mushroom quality is good; mushroom nutritional and medicinal value is regular to high or very high, or just unclear; and the mushroom price is expensive or not expensive. Large growers conceive the fresh product packed as a steady trend, and do not foresee new product lines in the near future, such as canned, cooked, or frozen. Small mushroom growers are mainly producing oyster mushrooms (*Pleurotus*) on a small scale (3.5-154 kg/week) for less than 11 years. The market trends usually affect the performance of these growers during all year. Perceptions of small growers included that: mushroom quality is good or excellent; mushroom nutritional and medicinal value is regular to high or very high, or just unknown; and the mushroom price is regularly or not expensive. Small growers conceive the product diversification as an important trend, and foresee new product lines, such as cooked or dried (Tables 2-3).

Retailers

Mushroom retailers who have been working for more than 11 years normally commercialize fresh *Agaricus* (champignon, 100%) and *Pleurotus* (90.9%) during all year, either packed (occasionally) or in bulk. Most mushrooms are bought at the main city market (81.8%, "Central de Abastos"). They offer to consumers several mushroom grades and prices, as it may take more than one day to commercialize all mushrooms. Retailers normally sell other products, mainly vegetables. Around half of retailers manage 10-59 kg per week (45.5%), while the rest (54.5%) between 100-875 kg per week. Perceptions of these retailers included that: mushroom quality is good to excellent (47.3%), or depends on the supplier (52.7%); mushroom nutritional and medicinal value is regular to high or very high, or just unknown; and the mushroom price is very or regularly expensive (73.7%), or not expensive (10.5%). Mushroom retailers

conceive the fresh product as a steady trend (54.5%), while others foresee new product lines, such as canned, cooked, or frozen (45.5%) [Tables 2-3].

Table 2. Main preferences on edible mushrooms along the chain production-consumption in central Mexico.

AS	Category	Growers (%)		RET (%) [n= 11]	RES (%) [n=23]	TO (%) [n=39]	Consumers (%)			
		La [n=2]	Sm [n=9]				L [n=120]	M [n= 166]	H [n= 115]	A
TP	Fresh	100	100	100	80.0	100	87.2[a]	76.2[a]	63.1[a]	75.5
	Canned	50	-	-	11.1	-	9.6[a]	20.2[a]	34.1[a]	21.3
	Wild	50	-	-	8.9	-	3.2[a]	3.6[a]	2.8[a]	3.2
CM	*Agaricus*-champignon	100	-	100	44.4	90.5	84.6[b]	81.7[b]	67.1[b]	77.7
	Agaricus-cremini	100	-	-	-	-	-	-	-	-
	Agaricus-portobello	100	-	-	4.4	-	-	-	-	-
	Pleurotus	100	100	90.9	31.2	9.5	15.4[b]	18.3[b]	32.2[b]	22.1
	Lentinula	50	-	-	-	-	-	-	0.7[b]	0.2
AM	< 0.5 kg	-	-	-	-	-	46.3	43.8	45.3	45.1
	0.5-1.9 kg	-	-	-	-	-	39.7	42.7	41.6	41.3
	2.0-3.9 kg	-	-	-	-	-	10.3	10.4	8.0	9.6
	≥ 4 kg	-	-	-	-	-	3.7	3.1	5.1	4.0
	< 10 kg	-	55.6	-	9.5	81.0	-	-	-	-
	10-29 kg	-	22.2	18.2	42.9	16.7	-	-	-	-
	30-59 kg	-	-	27.3	9.5	2.3	-	-	-	-
	60-99 kg	-	-	-	14.3	-	-	-	-	-
	100-1000 kg	-	11.1	54.5	14.3	-	-	-	-	-
	> 1000 kg	100	-	-	-	-	-	-	-	-
	Variable	-	11.1	-	9.5	-	-	-	-	-
NP	Fresh	-	22.2	54.5	78.3	79.5	77.4[c]	63.9[c]	37.8[c]	59.7
	Packed	100	22.2	-	-	-	-	-	-	-
	Cooked	-	33.4	18.2	-	2.5	11.4[c]	14.2[c]	38.7[c]	21.4
	Frozen	-	-	18.2	4.3	10.3	4.8[c]	13.0[c]	14.3[c]	10.7
	Dried	-	22.2	-	-	-	2.4[c]	4.1[c]	5.9[c]	4.2
	Others*	-	-	9.1	17.4	7.7	4.0[c]	4.8[c]	3.1[c]	4.0

AS= Aspect studied. La= Large. Sm= Small. RET= Retailers. RES= Restaurants. TO= "Tacos" outdoor stands. L= Low social level. M= Medium social level. H= High social level. A= Average from each category. TP= Type of product. CM= Cultivated mushrooms. AM= Amount of mushrooms per week. NP= New product lines.

[a] Data were significantly different between social levels: $p < 0.05$. $\mu = 13.3491$. Standard deviation= 0.4773. $X^2 = 71.479$.

[b] Data were significantly different between social levels: $p < 0.05$. $\mu = 2.4339$. Standard deviation= 2.7877. $X^2 = 11.073$.

[c] Data were significantly different between social levels: $p < 0.05$. $\mu = 5.5112$. Standard deviation= 12.5637. $X^2 = 39.284$.

* Canned, sliced, cleansed/disinfected, snacks, and/or blanched.

Restaurants

These establishments, which have been working for more than 11 years (61.1%), normally process recipes for main dishes containing fresh mushrooms (80%), mainly *Agaricus* (champignon: 44.4%; portobello: 4.4%) and *Pleurotus* (31.2%), although they can also use canned or wild mushrooms. Soups, pizzas and salads are other important ways in which mushrooms are prepared. Accordingly, mainly these recipes and the local tradition led restaurants to include mushrooms in their menu. Most restaurants consume less than 100 kg of fresh mushrooms per week (76.2%), between 10-29 kg/week of canned mushrooms (80%), and variable amounts of wild mushrooms during the rainy season (75.0%). Edible mushrooms are bought to suppliers, public markets, the main city market ("Central de Abastos"), and supermarkets (canned products). Perceptions of these restaurants included that: mushroom quality is good to excellent (77.8%) or depends on the supplier (19.4%); mushroom nutritional and medicinal value is regular to high or very high; and the mushroom price is very or regularly expensive (61.1%), or not expensive (13.9%). Important restaurants are getting good services from growers and suppliers, so they expressed no serious problems for getting mushrooms of good quality but at high prices. In terms of new product lines, restaurants expressed preference for the fresh product (78.3%), although they also mentioned other two alternatives: 1) Canned, sliced, and/or cleansed/disinfected (17.4%); and 2) Frozen mushrooms (4.3%) [Tables 2-4].

"Tacos" outdoor stands

"Tacos" outdoor stands process normally fresh *Agaricus* (champignon: 90.5%) and *Pleurotus* (9.5%) mushrooms during all year. Most stands (97.7%) manage up to 29 kg per week, which are bought mainly at public markets (92.8%); "tianguis" (2.4%); and the main city market (2.4%, "Central de Abastos"). Main recipes are Mexican cheese "tacos" and typical main dishes (95.3%). Perceptions of these outdoor stands included that: mushroom quality is good to excellent (83.3%) or depends on the place of purchase (11.9%); mushroom nutritional and medicinal value is regular to high or very high, or just unknown; and the mushroom price is very or regularly expensive (71.4%). Mushrooms are basically processed by these stands following customer's demand (61.9%), although traditional recipes (33.3%) were also an important factor. Most outdoor stands conceive the fresh product as a steady trend (79.5%), although a smaller proportion (20.5%) foresee new product lines, such as canned, sliced, cleansed/disinfected, cooked, or frozen (Tables 2-4).

Consumers

Most Mexican consumers eat fresh, canned and wild mushrooms since childhood. Canned mushrooms were more preferred by the high (34.1%) social level, in comparison with the medium (20.2%) and low (9.6%) levels. Consumers expressed that fresh and canned mushrooms were known by tradition (64.4%; ***i.e.***, a custom acquired within the family), oral communication (25.3%; ***i.e.***, a custom acquired outside the family, ***e.g.*** friends, traders), and the media (10.3%). The media were more important to know about mushrooms in the high (16.5%) social level, in comparison with the medium (5.6%) and low (8.8%) levels. However, tradition was the main factor promoting consumption of wild mushrooms (90.7%). Cultivated mushrooms and their main product lines available to consumers in Mexico are: fresh (*Agaricus*-champignon, *Agaricus*-portobello, *Agaricus*-portobellini, *Agaricus*-cremini, *Pleurotus*, *Lentinula*), canned *Agaricus* [whole, sliced, pieces, Mexican sauces ("salsa verde", "salsa pasilla"), "escabeche"], and canned *Pleurotus* (whole). There are predominant preferences for fresh (75.5%) mushrooms, followed by canned (21.3%) and wild (3.2%) mushrooms. *Agaricus* (77.7%) mushrooms are the most widely consumed, while *Pleurotus* (22.1%) and *Lentinula* (0.2%) represent a lower proportion. Consumers from the high social level buy more mushroom species and product lines than the medium and low levels. Fresh mushrooms are bought mainly in public markets (67.2%), supermarkets (14.7%), "tianguis" (8.6%), and greengroceries (2.7%) during all or most of the year. Canned mushrooms showed a different pattern, as they are bought in supermarkets (87.7%), convenience shops (6.6%), public markets (5.3%), and "tianguis" (0.4%).

Table 3. Main perceptions about fresh cultivated mushrooms along the chain production-consumption in central Mexico.

AS	Category	Growers (%)		RET (%) [n= 11]	RES (%) [n=23]	TO (%) [n=39]	Consumers (%)			
		La [n=2]	Sm [n=9]				L [n=120]	M [n= 166]	H [n= 115]	A
Q[a]	Excellent	-	44.4	36.8	66.7	38.1	40.8	44.9	41.0	42.2
	Good	100	55.6	10.5	11.1	45.2	44.2	45.6	50.2	46.7
	Regular	-	-	-	2.8	4.8	9.3	4.5	7.4	7.0
	DS	-	-	52.7	19.4	-	-	-	-	-
	DB	-	-	-	-	11.9	5.3	4.1	1.2	3.5
	B	-	-	-	-	-	0.2	0.4	0.2	0.3
	Unknown	-	-	-	-	-	0.2	0.5	-	0.3
P	V	50.0	11.1	73.7	61.1	71.4	75.0[b]	75.0[b]	76.6[b]	75.5
	NE	50.0	88.9	10.5	13.9	19.0	8.1[b]	16.7[b]	21.2[b]	15.3
	DB	-	-	-	-	-	8.8[b]	3.6[b]	2.2[b]	4.9
	Other	-	-	15.8	25.0	9.6	8.1[b]	4.7[b]	-[b]	4.3
N[c]	U	25.0	11.1	44.8	12.4	38.1	51.1	42.9	28.3	40.8
	VH	62.5	61.1	18.4	66.3	34.5	30.6	44.6	63.8	46.3
	RL	12.5	27.8	36.8	21.3	27.4	18.3	12.5	7.9	12.9

AS= Aspect studied. La= Large. Sm= Small. RET= Retailers. RES= Restaurants. TO= "Tacos" outdoor stands. L= Low social level. M= Medium social level. H= High social level. A= Average from each category. Q= Quality (flavour, appearance). P= Price. N= Nutritional and medicinal value for *Agaricus*, *Pleurotus*, and *Lentinula*. DS= Depending on the supplier. DB= Depending on where mushrooms are bought. B= Bad, very bad. V= Very or regularly expensive. NE= Not expensive. U= Unknown, unclear. VH= Very high, high. RL= Regular; low, very low.

[a] Data were significantly different between all groups of the chain. Fresh *Agaricus*-champignon: $p < 0.05$. $\mu = 4.5012$. Standard deviation= 0.7550. $X^2 = 25.620$. Fresh *Pleurotus*: $p < 0.05$. $\mu = 4.6074$. Standard deviation= 0.7340. $X^2 = 16.004$.

[b] Data were significantly different between social levels: $p < 0.05$. $\mu = 3.8128$. Standard deviation= 2.6893. $X^2 = 30.643$.

[c] Cultivated, canned and wild mushrooms were combined in this item for RES and consumers.

The amount of mushrooms bought weekly varied: fresh (up to 1.9 kg: 86.4%), canned (< 0.5 kg: 55.6%), and wild (up to 1.9 kg: 93.4%) to be eaten in main dishes or in salads and pizzas. Although fresh mushrooms predominate (59.7%) in consumers' preferences, new product lines are also emerging, such as cooked (21.4%), frozen (10.7%), dried (4.2%), and various (4.0%: canned, snacks, blanched, sliced, and/or cleansed/disinfected) mushrooms. Consumers from the high social level are particularly demanding new product lines. The frequency of mushroom consumption is normally 1-4 times per week (49.4%), or 1-2 times per month (41.6%). Perceptions in Mexican consumers included that: mushroom flavour, appearance and quality are good to excellent (88.9%), despite international standards are not yet thoroughly reached in either cultivated or wild mushrooms. Mushroom nutritional and medicinal value is high or very high (46.3%), just unknown (40.8%), or regular to very low (12.9%). The mushroom price is considered very or regularly expensive by all social levels (fresh: 75.5%; canned: 72.2%; wild: 62.6%) [Tables 2-4]. This perception is correlated with historical documental records and databases, because the inflation-free minimum wage has decreased significantly during the period 1940-2002 (63.9%) affecting directly the purchasing power of Mexican consumers. Although the consumer price of most popular foods also decreased during the same period (20.3-54.0%), the highest proportion (86.2%) was recorded for

Agaricus-champignon amongst items studied (Table 5). Despite this decrease, the current average consumer prices of *Agaricus*, *Pleurotus*, and *Lentinula* mushrooms still are more expensive than several foods widely consumed, such as meat, chicken, bean, tomato, egg, avocado, rice, milk, sugar and nopal (Fig. 2). Furthermore, the annual variation of mushroom prices between cities, places of purchase (*e.g.*, *Agaricus*-champignon: USD $ 1.04-5.17 per kg), and regions (*e.g.*, *Agaricus*-champignon: USD $ 2.33-5.43 per kg), is high affecting consumption (data not shown).

Table 4. Main preferences about fresh cultivated mushrooms associated to a part of the chain production-consumption in central Mexico.

Aspect studied	Category	RES (%) [n=23]	TO (%) [n=39]	Consumers (%)			
				Low [n=121]	Medium [n= 163]	High [n= 117]	A
Main season for mushroom dishes	All year	60.0	88.4	53.6	56.1	50.3	53.3
	Spring-summer	20.0	-	17.1	18.8	31.8	22.6
	Other	8.6	7.0	23.5[a]	18.5[a]	11.0[a]	17.6[a]
	Rainy season	8.6	4.6	5.8	5.6	2.8	4.8
	Autumn-winter	2.8	-	-	1.0	4.1	1.7
Where mushrooms are bought	Public markets	14.3	92.8	79.1	70.5	52.0	67.2
	Supermarkets	-	-	6.2	10.4	27.6	14.7
	"Tianguis"	-	2.4	4.8	11.5	9.8	8.6
	Greengroceries	-	-	2.3	1.6	4.1	2.7
	Main city market	28.6	2.4	-	-	-	-
	Supplier	57.1	-	-	-	-	-
	Other	-	2.4	7.8	6.0	6.5	6.8
Way of preparation/ cooking	Main dishes	63.8[b]	28.6	95.0[b]	85.0[b]	66.3[b]	82.2[b]
	Soups	34.0	-	-	-	-	-
	Mexican cheese "tacos"	-	66.7	-	-	-	-
	Salads-pizzas	2.1	4.8	5.0	15.0	33.7	17.8

RES= Restaurants. TO= "Tacos" outdoor stands. A= Average from each category.

[a] People expressed: by individual taste, or depending on the mushroom price, quality, and availability.

[b] People expressed: 1) Associated to all kinds of meat; 2) Combined with Mexican traditional sauces ("salsas", "mole", "pipián", "chipotle"); 3) Associated to all kinds of local vegetables (chillies, herbs, maize, nopals, tomatoes, potatoes, onions, garlics); 4) Combined with traditional dishes ("tortas", "tacos", "tamales", "empanadas", "pozole", and others); and 5) Pizzas, and mushrooms stuffed with cheese or savoury mixture.

DISCUSSION

The promotion of mushroom consumption in Mexico has been limited due to the lack of thorough consumer research, as well as the theoretical and practical basis of marketing. Mushroom consumption has developed so far basically by inertia selling or grower-oriented strategies. At present, the establishment of suitable marketing strategies are critical to allow further development of the mushroom industry. Mushroom growers are heterogeneous in mushroom production; and they are not suitably developing and/or improving channels of distribution, services, mushroom quality, and new product lines. Retailers, chefs/restaurants, and "tacos" outdoor stands are important elements of the chain production-consumption, but mushrooms are not their main products and are only confined to small sections. They normally process

and/or sell a variety of other products. Mexican consumers have not been well informed about the nutritional and medicinal value of edible mushrooms. At present, despite mushrooms are considered as very or regularly expensive, consumers buy them mainly by individual taste in public markets, "tianguis" and groceries where quality is low and prices high. They can get better mushroom quality and a variety of product lines at supermarkets, but prices are even higher. Fresh mushrooms predominate in consumers' preferences, whereas the canned product is more demanded by the high and medium social levels and is basically available at supermarkets and convenience shops. New product preferences are emerging, such as cooked, frozen, dried, and various (canned, snacks, blanched, sliced, cleansed/disinfected) mushrooms. A national strategy to increase mushroom consumption should be based on the suitable support and funding from all sectors involved within the chain production-consumption, including the academic sector, in order to make mushrooms available at the lowest cost to more consumers from all social levels and regions.

Table 5. Decrease of average consumer prices from *Agaricus*-champignon mushrooms, as well as those from some other foods widely consumed.

Year	CPI (2002= 100)	MW (USD)	Mushroom (*Agaricus*) (USD/kg)	Other foods (USD/kg)				
				Meat	Tomato	M	Sugar	Rice
1940	0.0025067	11.40	24.78	4.50	1.57	1.20	1.45	1.53
1950	0.0098895	6.24	21.23	5.15	1.21	0.85	1.02	1.47
1960	0.019179	7.45	18.27	7.20	0.83	0.96	0.83	1.45
1970	0.023952	12.07	17.87	8.26	1.18	1.02	0.75	1.63
1980	0.11218	12.98	16.13	9.94	1.46	0.69	0.67	1.51
1990	16.791	6.14	3.25	4.87	1.37	0.65	0.63	1.41
2000	89.690	4.05	5.08	3.32	1.16	0.81	0.77	0.83
2001	94.967	4.10	3.66	3.25	1.03	0.80	0.76	0.72
2002	100.204	4.11	3.40	3.19	1.25	0.76	0.70	0.70
Decrease (%)		-63.98	-86.28	-29.17	-20.34	-36.17	-51.83	-54.09

CPI= Consumer price index according to the methodology from the Bank of Mexico. MW= Inflation-free minimum wage. M= Milk (USD/l). Exchange rate: USD $ 1.00= $ 9.66 Mexican pesos. Mushroom (*Agaricus*) and food prices taken from diverse references, databases, and estimations, were subjected to deflation (Martínez-Carrera *et al*., 1991b, 1992, 2000; Martínez-Carrera, 2000, 2002; INEGI, 2000).

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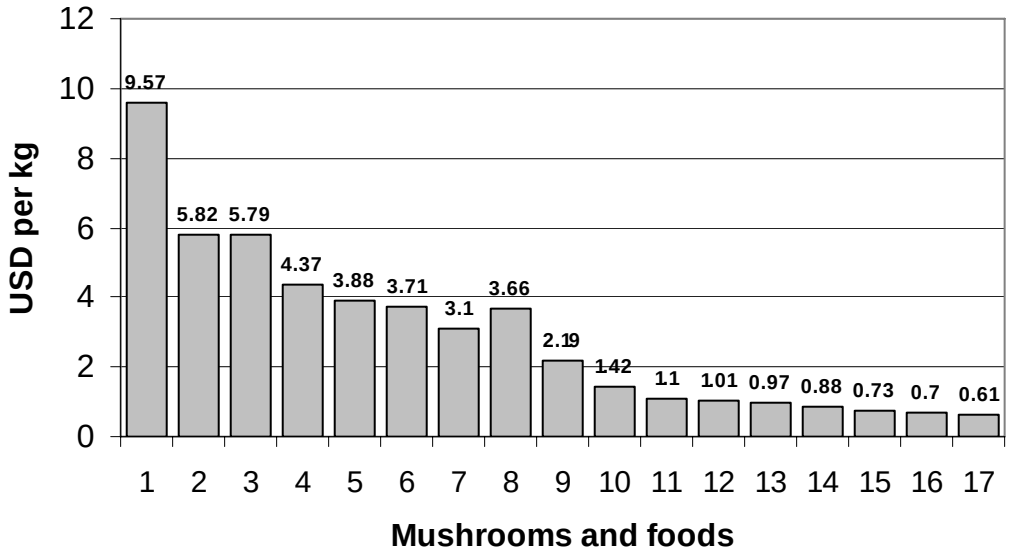

Fig. 2. Comparison of current consumer prices (2002, average) of edible mushrooms in central Mexico, compared with those from several other foods widely consumed. Average data per kilogram recorded in this study (except where otherwise indicated). 1: Fresh shiitake (*Lentinula edodes*). 2: Fresh *Agaricus*-cremini. 3: Fresh *Agaricus*-portobello. 4: Fresh oyster mushrooms (*Pleurotus*). 5: Canned *Agaricus* (average: whole, sliced, pieces, "escabeche"). 6: Fresh *Agaricus* (price from databasis). 7: Fresh *Agaricus*. 8: Meat (popular milled beef). 9: Chicken (legs). 10: Bean (packed). 11: Tomato. 12: Egg (12 per box). 13: Avocado. 14: Rice (packed). 15: Milk (Liter). 16: Brown sugar (price from databasis). 17: Nopal. Exchange rate: USD $ 1.00= $ 9.66 Mexican pesos.

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