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Short Communication

Survey Review of Microbial Quality on Food Products Acquired from Internet and Local Retail Markets (VA)

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Abstract

Consumers' desire to procure perceived high-quality products directly from producers or stores by mail delivery has been increasing. However, few reports are available on the food safety associated with the prevalence of microbial pathogens on food products sold through the Internet markets. The present article compiled and reviewed our prior surveys on microbial quality of food products acquired via the Internet and from local retail markets. Food products reviewed include ground beef, fish fillets, lamb meat, and shiitake mushroom. Our findings suggest that the microbial quality was almost similar among food products acquired from both local and Internet markets, and, due to the possible presence of unacceptable levels of microbial counts and occurrences of foodborne pathogens, we recommend careful practices of handling food products, regardless of market source, to prevent foodborne illness.

Keywords: Microbial quality; *E. coli*; *Salmonella*; *Listeria*; Internet and local market

Introduction

The Internet has become an important means for producers and distributors within or across countries to market food items directly to consumers. This business approach satisfies consumers' desire to procure perceived high-quality products directly from producers or stores by mail delivery [1]. By paying higher prices, some consumers may believe that they are getting products of superior quality. However, no scientific evidence supports the assumption that Internet food products are of better microbial quality than are locally purchased products, and few reports of microbial data from food items sold via the Internet are available. Therefore, the current article compiles and summarizes a series of previous microbiological surveys we conducted on beef [2], fish fillets [1], lamb meat [3], and shiitake mushrooms [4] procured through the Internet (U.S.) in comparison with those obtained at local (Virginia) retail markets.

Materials and Methods

Appropriate amounts of beef products, fish fillets, lamb meat, and shiitake mushrooms were purchased from Internet and local retail markets, depending upon their availability at each venue. All local retailers were located within a radius of 50 miles from Virginia State University (Petersburg, VA, USA). In brief, food product samples purchased in duplicate are as follows: 1) beef study: four types of beef products consisting of Locally Acquired Raw Ground Beef (LRG) and Frozen Beef Patties (LFP) and Internet-Acquired Frozen Ground Beef (IFG) and frozen beef patties (IFP); 2) fish fillet study: four types of raw (non-frozen) fish fillets consisting of Locally Acquired Catfish (LCA), salmon (LSA), tilapia (LTI), and trout (LTR) and Internet-acquired samples of same (ICA, ISA, ITI, and ITR); 3) lamb meat study: two types of frozen meat products from lamb, consisting of Locally Acquired Ground (LLG) and chops (LLC) and Internet-acquired samples of same (ILG and ILC); and 4) shiitake mushroom study: two forms of shiitake mushrooms consisting of locally acquired whole (LW) and sliced (LS) and Internet-acquired samples (IW and IS). Samples were maintained at appropriate temperatures (either frozen or refrigerated, depending upon the nature of the products) during shipping and transportation to laboratory for analysis.

Upon arrival at the laboratory, each sample portion of 25 g from multiple locations within each sample package was homogenized in 225 ml of sterile peptone water (0.1%), and its appropriate dilutions of the homogenate were surface plated using Standard Method Agar (SMA) for aerobic mesophile counts after incubating at 36°C for 48 h and psychrotroph plate count after incubation at 7°C for 7 days. Yeast and mold counts were determined using Acidified Potato Dextrose agar after incubating at 25°C for 5 days. In addition, each homogenated sample was surface-plated on Baird-Parker agar supplemented with egg yolk tellurite for *Staphylococcus aureus* counts. Presumptive *S. aureus* colonies (black, circular, shiny colonies with halos) were transferred to SMA for *S. aureus* confirmation using the rabbit plasma test (Remel, Lenexa, KS) and a gram-stain kit (Fisher Diagnostics, Middletown, VA) before microscopic morphologic examination. Total coliform and *E. coli* counts were determined using the three-tube Most-Probable-Number (MPN) evaluation. *Salmonella* and *Listeria* detections were performed using AOAC-approved or performance-tested methods [5,6]. After incubation at appropriate temperature for 24 - 48 h, up to three different colonies per isolation were identified to species by API 20E for *Salmonella* and API *Listeria* kits for *Listeria*.

Results and Discussion

Findings in the beef study revealed that the general microbial levels were similar among ground meat products from local and Internet markets with the exception that LFP had overall lower bacterial levels (mesophiles, psychrotrophs, and coliforms) than any other product group (Table 1). According to the limit recommended by the International Commission on Microbiological Specification

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Table 1: Microbial levels and prevalence in local and Internet procured food products.

Sample type	Sample ID	Microbial population (log CFU/g or log MPN/g)				Microbial prevalence (%)			
		AM	PT	YM	CF	EC	SM	LM	SA
Beef	LRG	5.4±0.3	6.0±0.4	2.3±0.3	1.3±0.1	17.5	ND	5	ND
	LFP	3.4±0.2	3.3±0.3	1.4±0.1	0.7±0.1	2.8	ND	11.1	ND
	IFG	5.0±0.3	5.4±0.4	1.7±0.2	1.3±0.1	26.3	ND	10.5	ND
	IFP	5.1±0.3	5.6±0.4	2.0±0.3	1.3±0.1	29	ND	7.9	ND
Fish fillet	LCA	6.0±0.2	6.8±0.3	ND	2.5±0.2	16.7	ND	22.2	ND
	LSA	5.5±0.3	6.4±0.3	ND	1.9±0.3	0	ND	9.4	ND
	LTI	5.4±0.4	6.0±0.4	ND	1.7±0.3	8.3	ND	2.8	ND
	LTR	5.6±0.2	6.3±0.3	ND	1.8±0.3	0	ND	2.8	ND
	ICA	6.0±0.3	6.3±0.3	ND	2.1±0.3	9.4	ND	25	ND
	ISA	5.4±0.2	6.1±0.2	ND	1.4±0.2	2.9	ND	11.8	ND
	ITI	5.6±0.3	5.9±0.5	ND	2.0±0.3	3.1	ND	18.8	ND
	ITR	6.3±0.2	6.9±0.3	ND	2.0±0.3	2.9	ND	8.8	ND
Lamb	LLG	7.2±0.9	7.6±0.8	ND	2.7±1.4	45	0	25	0
	LLC	5.2±2.0	5.4±2.0	ND	1.5±1.2	9.1	0	13.6	0
	ILG	4.9±1.5	5.5±2.7	ND	1.3±1.0	15	0	35	0
	ILC	4.3±1.8	4.5±2.2	ND	0.8±0.6	16.7	16.7	16.7	16.7
Shiitake mushroom	LW	6.9±1.3	ND	5.8±0.9	1.6±1.0	0	0	0	ND
	LS	7.5±1.1	ND	6.0±0.3	1.9±1.1	0	0	0	ND
	IW	4.2±0.6	ND	2.2±0.6	0.5±0.0	0	0	0	ND
	IS	3.6±0.3	ND	1.9±0.7	0.5±0.0	0	0	0	ND

*AM: Aerobic Mesophiles; PT: Psychrotrophs; YM: Yeast and Mold; CF: Coliforms; EC: *Escherichia coli*; SM: *Salmonella*; LM: *Listeria monocytogenes*; SA: *Staphylococcus aureus*; ND: Not Determined. Data are excerpted from prior studies (beef [2], fish fillet [1], lamb meat [3], shiitake mushroom [4]).

for Foods [7], about 100, 74, 71, and 53%, respectively, of LFP, IFG, IFP, and LRG samples tested in the present study had aerobic mesophile counts within the recommended range for good-quality (≤ 5 X 10^5 CFU/g), but 20% of LRG and 5% each of both IFG and IFP exceeded the acceptable level (> 5 X 10^6 CFU/g). In addition, frozen ground beef products sold over the Internet had a higher prevalence of coliform and *E. coli* contamination than locally available products. While *Salmonella* was isolated from LFP only, *L. monocytogenes* were prevalent in both local (5.0 - 11.1%) and Internet (7.9 - 10.5%) samples.

Overall microbial levels in fish fillets regardless of fish types were similar between local and Internet markets. Approximately 57.1% of localand 48.5% of Internet retail fillets tested had aerobic mesophile counts within the recommended range for good quality, and 29.3 and 37.9% of local and Internet samples, respectively, were marginally acceptable (5 X 10^5 to ≤ 5 X 10^7 CFU/g). Ninety-eight percent of fillets met *E. coli* level in good-quality fresh fish (≤ 11 CFU/g, ICMSF). Fish fillets acquired from the Internet had higher prevalence of *L. monocytogenes* than locally procured ones.

Results in the lamb meat study demonstrated that the microbial levels in locally acquired meat on average were higher than those in samples acquired via the Internet. Ground meat had higher microbial levels than chop meat. Approximately 6, 44, 44, and 56%of LLG, LLC, ILG, and ILC, respectively, samples showed aerobic mesophile counts within the recommended range for good quality (≤ 5 X 10^5 CFU/g), but the majority (44 - 67%) of samples was marginally acceptable (5 X 10^5 to 5 X 10^7 CFU/g). In addition, *E. coli* counts found in all meat samples regardless of their type and market source didn't show any difference. Although the majority (87%) of meat samples met the criteria for food quality raw meat in terms of *E. coli* counts, meat products tested in our study revealed the prevalence of *E. coli* and *L. monocytogenes* contamination. Occurrences of *E. coli* and *Salmonella* are observed in ILC sample.

Microbial levels on shiitake mushrooms (dried forms) purchased via the Internet were lower than on those (fresh forms) from local retail markets. All IW and IS had aerobic mesophile counts ≤ 5 X 10^5 CFU/g, and 35% of LW and 62.5% of LS had aerobic mesophile counts ≥ 5 X 10^7 CFU/g. While *E. coli*, *Salmonella*, and *L. monocytogenes* were not detected in any of the samples, about 11% of the 28 local mushroom samples were positive for *Listeria* spp.

Conclusion

This article reviews our prior studies on the differences in microbial quality between locally purchased products and products sold through the Internet. Internet products in general are marketed at higher prices than those sold locally, even before the addition of shipping and handling fees. Given the levels of microbial counts and the possible occurrences of foodborne pathogens on food products surveyed, careful handling and cooking of products by consumers, regardless of the market source, is recommended to prevent possible foodborne illness. Furthermore, elaborated and in-depth research is needed to determine the cause(s) of microbial occurrence and to

support the healthy development of the emerging Internet market.

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