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THE RATE OF INTESTINAL PARASITIC INFECTION IN RAW VEGETABLES AT A RESTAURANT IN TRA VINH CITY, VIET NAM

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Abstract – *The objective of the study is to determine the rate of intestinal parasite infection in raw vegetables at restaurants in Tra Vinh City. The research employed a descriptive cross-sectional study on 96 selected vegetable samples. The results showed that the overall parasite infection rate was 55.2%, with specific infection rates for various vegetables as follows: mustard greens (68.4%), herbs (68.4%), chives (60.0%), laska leaves (47.4%), and lettuce (31.6%). Analysis reveals that Fasciola spp. eggs accounted for the highest proportion among the infectors (38.5%), followed by Ascaris lumbricoides (A. lumbricoides) eggs (19.8%), hookworm eggs (12.5%), roundworm larvae (11.5%), Trichuris trichiura (T. trichiura) eggs (2.1%), and Clonorchis sinensis (C. sinensis) eggs. This research contributes to enhancing community knowledge of parasite contamination in raw vegetables, thereby aiding in infection prevention and health improvement. Additionally, the research established a database for larger-scale surveys in various localities.*

Keywords: infection rate, parasite, raw vegetables, Tra Vinh City.

I. INTRODUCTION

Raw vegetables are an important source of vitamins, fibers, and minerals for the body, along with their characteristic flavor, so raw vegetables are very popular. However, improper washing of these vegetables may leave toxic chemicals such as pesticide residues, growth stimulants, and preservatives. Furthermore, a critical yet often overlooked concern is the existence of parasites on vegetables that can affect human health. Tra Vinh City is currently developing step by step, and many infrastructures are being upgraded, and industrial parks are being built. In addition, the food service business is also gradually developing, especially small and medium-sized restaurants. Regarding the current situation, this study is conducted to determine the rate of palm parasite infection in raw vegetables of restaurants in Tra Vinh City, aiming to provide a better understanding of the status of palm parasite infection when eating raw vegetables in dishes at restaurants.

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II. RESEARCH OVERVIEW

Raw vegetables are rich in fiber and micronutrients. However, numerous studies [1–3] have warned that consuming raw vegetables can pose a high risk of parasitic infections if not handled properly. In Vietnam, the prevalence of parasites in raw vegetables has been examined. A 2021 investigation by Ho Thi Dung et al. [1] indicated a significant prevalence of parasite infestation in vegetables from Hue City and surrounding areas, totalling 90.6%. Similarly, Huynh Ngoc Thao et al. [2] discovered that 81.50% of raw vegetables were infested with parasites. Nguyen Van Hung et al. [3] reported a contamination rate of 67.2%. Furthermore, Do Chi Thanh et al. [4] indicated that intestinal parasites were detected in 63.8% of raw vegetable samples.

Research conducted at various markets in Tra Vinh City indicated that while the prevalence of helminth-contaminated vegetables shows a declining trend, it remains considerably high. For instance, the study by Nguyen Thi Thanh Tuyen [5] found a contamination rate of 53.71%, which is lower than that reported by Tran Thanh Quang et al. [6] at 61.67%, and significantly lower than

the rate found by Le Cong Van et al. [7], which reach 97.90%.

Internationally, Khan et al. [8] reported a parasitic contamination rate of 19.70% in Pakistan, but Alade et al. [9] identified an intestinal parasite frequency of 40.7%. The results indicate that the prevalence of parasite contamination, especially helminth infections, in raw vegetables in Vietnam is greater than in numerous other nations. This disparity can be ascribed to meteorological circumstances, geographic location, and regional farming practices.

The elevated incidence of parasite contamination in raw vegetables is a substantial public health issue. However, in Tra Vinh, few studies have examined the contamination rate of raw vegetables served in restaurants, leading to a lack of comprehensive data for comparison and discussion. This gap highlights the rationale and motivation for this study, which aims to raise public awareness about health risks associated with the consumption of raw vegetables.

III. RESEARCH METHODS

A. Time and location of the study

The research was conducted from June to September 2023 at restaurants in Tra Vinh City. Testing vegetable samples was carried out at the Parasitology Laboratory, Faculty of Medicine and Pharmacy, Tra Vinh University.

B. Criteria for sample selection

Based on the study population, the study outlines the inclusion and exclusion criteria for selecting raw vegetable samples and survey participants in restaurants located in Tra Vinh City (Table 1). The criteria ensure that only suitable vegetable samples and appropriate participants are included.

C. Research sample size

The sample size was calculated using the sample size formula (Formula (1)) for estimating population proportions.

Table 1: Eligibility criteria for raw vegetable samples and restaurant managers in Tra Vinh City

Population	Inclusion criteria	Exclusion criteria
-Raw vegetables sold at restaurants in Tra Vinh City, including five main types: chives, lettuce, herbs, *laska leaves*, and mustard greens.	- Raw vegetable samples are fresh, not crushed, not rotten, and do not have unusual colors at the time of the study.	- Raw vegetables are not fresh and crushed, soggy, or have unusual colors during storage.
-Restaurant owners or restaurant managers work in Tra Vinh City.	-The restaurant owners or restaurant managers selected for the survey agree to participate in the study.	- The restaurant owners or restaurant managers do not consent to participate in the study.

$$n = z^2_{1-\alpha/2}\frac{p(1-p)}{d^2} \qquad (1)$$

n: the required research sample size.

Nguyen Thi Thanh Tuyen [5] conducted a research in 2022, the results obtained the overall parasite infection rate on the tested vegetable samples was 53.7% (p = 0.5371), which the desired deviation between the sample rate and the population rated d = 0.1 and α = 0.05 statistical significance level = 1.96, the Z value obtained from the Z table corresponds to the selected α value. So, this study has 96 samples.

D. Collection method

The study used a descriptive cross-sectional design with a multi-stage sampling method. The sample size was 96 vegetable samples from restaurants in Tra Vinh City from June to September 2023. The information collected by a questionnaire includes characteristics and knowledge of the restaurant owner or manager about the parasitic infection. In addition, data on the infection was rated for several parasites on raw vegetables, consisting of *A. lumricoides eggs*, *T. trichiura* eggs, hookworm eggs, roundworm larvae (*Nematoda*), *Fasciola spp* eggs, and *C. sinensis* eggs through sample manipulation techniques. The samples collected were processed through several steps.

Step 1: The researchers collected samples of raw vegetables at restaurants in six randomly selected wards to obtain 16 samples of vegetables

in each ward. Technical activities are carried out at the parasitology laboratory of the Faculty of Medicine and Pharmacy of Tra Vinh University. This place provides important equipment, such as optical microscopes and centrifuges.

Step 2: The Romanenko method was used to investigate the presence of helminths in raw vegetable samples. The vegetable samples were immersed in a wash basin containing 1/2–2/3 clean water and left for 10–12 hours. Then, the vegetable samples were continuously washed before collecting all the washing water. It was left to settle for six hours. The water at the bottom is collected. The centrifuge method was used to settle the sediment, which was taken to investigate the presence of parasites under microscopy [10].

Step 3: The sediment of the raw vegetable was mounted on microscope slides and covered with a coverslip by direct microscopic examination. Each preparation was systematically examined under low- (10x) and high-power (40x) magnification to identify the parasite species, including eggs and larvae [11]. While waiting for the samples to be processed and results to be obtained, researchers conducted interviews with the restaurant owners (or managers), with their consent, using a structured questionnaire to gather information about factors related to parasite infections. The researchers read the questionnaire aloud, allowing restaurant owners (or managers) to select the most appropriate answers.

E. Ethical considerations

The study was conducted after receiving approval from the Biomedical Ethics Committee of Tra Vinh University, decision number 218/GCT-HĐĐĐ, reviewed and approved through the expedited process on June 18, 2023.

IV. RESULTS AND DISCUSSION

A. Rate of common parasitic infections on raw vegetables

The results presented in Figure 1 found that 55.2% of vegetable samples were infected with parasites. A significant proportion of vegetables sold at restaurants are infected with parasites. This rate is equivalent to the study of Nguyen Thi Thanh Tuyen [5] with a rate of 53.7%, but is notably higher than Tran Thi Thanh Thao's findings [10] of 19% and Nguyen Van De's [12] at 48.3%. Conversely, this study is lower than both the study of Tran Thanh Quang et al. [6] with an infection rate of 61.7% and the study of Le Cong Van et al. [7] with a rate of 97.9%. The rate of parasitic helminth infection in this study is also much lower than that of Huynh Ngoc Thao et al. [2], who found 81.5% of vegetables infected with parasites. However, the study only found parasitic helminths that can cause disease in humans, leading to this difference compared to previous studies with protozoa. However, the results of this study surpass the findings in the study by Khan et al. [8], out of a total of 800 vegetable samples tested, 158 samples were infected with parasites, equivalent to a rate of 19.7% and the study of Alade et al. [9] had 61 vegetable samples out of a total of 150 samples infected with parasites, accounting for a rate of 41.0%. This shows that the rate of parasitic helminth infection on vegetables in Nigeria is higher than in several countries in the world. The climatic conditions, geographical location, and farming practices have had a significant impact on the rate of parasite infection on vegetables.

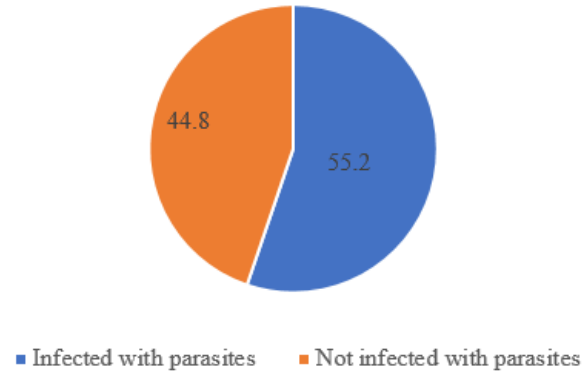

Fig. 1: Rate of common parasitic infections on raw vegetables

B. Infection rate of parasites on each raw vegetable

Table 2: Infection rate of parasites on each raw vegetable

Vegetable type (n)	*A.lumbricoides* eggs n (%)	*T.trichiura* Eggs n (%)	Hookworm eggs n (%)	Roundworm larvae n (%)	*Fasciola spp* eggs n (%)	*C.sinensis* eggs n (%)
Chives (20)	6 (30.0)	0 (0.0)	3 (15.0)	1 (5.0)	11 (55.0)	0 (00.0)
Lettuce (19)	1 (5.3)	1 (5.3)	1 (5.3)	3 (15.8)	3 (15.8)	0 (0.0)
Mustard greens (19)	8 (42.1)	0 (0.0)	1 (5.3)	3 (15.8)	12 (63.2)	0 (0.0)
Laska green (19)	1 (5.3)	0 (0.0)	1 (5.)	3 (15.8)	5 (26.3)	0 (0.0)
Herbs (19)	3 (15.8)	1 (5.3)	6 (31.6)	1 (5.3)	6 (31.6)	0 (0.0)
Total (n=96)	19 (19.8)	2 (2.1)	12 (12.5)	11 (11.5)	37 (38.5)	0 (0.0)

The results from Table 2 showed that our study results have the highest rate of large trematode egg infection, with 38.5%. The rate is higher than the research of Le Cong Van [7] at 28.1%. In addition, the study of Tran Thanh Quang et al. [6] and Nguyen Thi Thanh Tuyen [5] did not find large trematode eggs at all (0.0%). There were 12 samples of mustard green with the highest infection rate of 63.16%. With the rest of the vegetables, lettuce has the lowest rate of infection with large fluke eggs (15.79%). The studies have shown that the rate of infection with worm larvae on mustard green is quite high. Mustard green is a coriander that has many good uses for human health and is also commonly used in cakes such as cakes, shrimp cakes, bean cakes, pancakes, and other Vietnamese dishes.

To avoid affecting the health of consumers, green leaf should be thoroughly washed with water many times to minimize the presence of large leaf fluke eggs on green leaf in family meals. This study found 19.8% of *A. lumbricoides* eggs on raw vegetables. This result is lower than the study of Huynh Ngoc Thao et al. [2] with 34.3%, Pham Van Hung et al. [3] with 36.2%, and Tran Thi Thanh Thao [10] with 25.4%. However, it is higher than the research of Nguyen Thi Thanh Tuyen [5], with 2.9% of vegetable samples contaminated with A.lumbricoides eggs. According to the assessment of experts in the external environment, the shape of human *A. lumbricoides* eggs and *A. lumbricoides* eggs of other animals are very similar, so this study only identifies them as common roundworm eggs, but does not specify the species. The rate of vegetables infected with *Taenia spp* eggs is 2.1%. The results of this study are consistent with the study of Le Cong Van [7], with the same infection rate of 2.1%. Compared to the infection rate in this study, it is lower than that of Ho Thi Dung et al. [1] with an infection rate of 13.1% and the study of Huynh Thi Ngoc Thao et al. [2] with an infection rate of 11.2% and has a higher infection rate than the study of Tran Thi Thanh Thao [8] with an infection rate of 1.7%. The rate of vegetables infected with hookworm eggs is 12.5%, that is much lower than the study of Huynh Ngoc Thao et al. [2] (31.5%), and Pham Van Hung [3] (24.6%), but is similar to the study of Do Chi Thanh et al. [4] on raw vegetables sold at traditional markets in Tan Phu District, Ho Chi Minh City with the infection rate of 10.2%.

This study found that the rate of infection with roundworm larvae is 11.5%. This rate is significantly lower than that in Huynh Ngoc Thao et al.'s paper [2], with 57.8% of vegetable samples infected with hookworm or *S. stercoralis* larvae. This research is equivalent to the study of Pham Van Hung et al. [3] with a rate of 51.3%, but it is lower than the rate of 49.7% reported by Nguyen Thi Thanh Tuyen [5]. The infection rate of *C. sinensis* eggs on raw vegetables has not been found. In Vietnam, *C. sinensis* infection is mainly concentrated in the Northern provinces and the Central provinces, which is consistent with the distribution of snail groups considered inherently intermediate hosts I of liver flukes [5]. In addition, freshwater fish species of the Cyprinidae family, or crucian carp, are intermediate hosts II of *C. sinensis*. People in the North and Central regions have the habit of eating raw fish salad [11, 13]. These are the characteristics that make *C. sinensis* infection more common in the North and Central regions than in the South. The study has not yet found *C. sinensis* in all vegetable samples, which is completely consistent with the above epidemiological characteristics.

C. General parasite infection status on each type of raw vegetables and the relationship between parasite infection status and each type of raw vegetables

Table 3: Frequency of overall parasite infection rate on each type of raw vegetables and the relationship between parasite infection status and each type of vegetable

Vegetable type (n)	Parasite infection status		P	PR KTC 95%
	Infection n (%)	Not infected n (%)		
Chives (20)	12(60.0)	8(40.0)	0.628	1.11 (0.74–1.68)
Lettuce (19)	6(31.6)	13(68.4)	0.021	1.93 (0.98–3.84)
Mustard greens (19)	13(68.4)	6(31.6)	0.196	1.32 (0.91–1.91)
Laska leaves (19)	9(47.4)	10(52.6)	0.443	0.83 (0.50–1.38)
Herbs (19)	13(68.4)	6(31.6)	0.196	1.32 (0.91–1.91)

The results of Table 3 show the parasite infection rate on herbs (68.4%), chives (60.0%), laska leaves (47.4%) and lettuce (31.6%). This rate is lower than the study of Nguyen Thi Thanh Tuyen [5], with the parasite infection rate on lettuce (60.0%), chives (72.0%), and the study by Le Cong Van [7], with laska leaves and herbs showing 100%. In addition, the infection rate on lettuce is much lower than the study of Ho Thi Dung et al. [1], with an infection rate of 77.8%. The study also found that mustard green is higher than the study of Nguyen Van De [12], which showed 12.7%.

There was a difference in the rate of helminth infection on chives compared to other vegetables, in which lettuce and herbs have the highest and lowest rates of helminth infection are lettuce. Only lettuce has an association between vegetables and parasite infection. The rest did not find any association between helminth infection and each vegetable.

V. CONCLUSIONS AND RECOMMENDATIONS

A. Conclusion

The study shows that the overall parasite infection rate was 55.2%. Among these, infection rates for various vegetables are as follows: mustard greens (68.4%), herbs (68.4%), chives (60.0%), laska leaves (47.4%), and lettuce (31.6%). Particularly, analysis reveals that Fasciola spp. eggs accounted for the highest proportion among the infectors (38.5%), followed by *Ascaris lumbricoides* (*A. lumbricoides*) eggs (19.8%), hookworm eggs (12.5%),

B. Recommendations

First, functional units should strengthen the monitoring and management of food hygiene and safety conditions at food service establishments. Next, Sub-department of Food Hygiene and Safety should conduct communication on loudspeakers, radios installed in crowded places, television, newspapers, or organize communication sessions for consumers, food service businesses about appropriate knowledge and practices in vegetable hygiene and vegetable preservation to avoid parasitic infection. Moreover, there needs to be more research on finding the rate of parasite infection on raw vegetables in restaurants to help restaurant owners or vegetable washers reduce the level of parasite infection on raw vegetables to the lowest level.

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