



Historical Details about the Meat Consumption and Taeniasis in Joseon Period of Korea

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Abstract: Previous paleoparasitological studies of Joseon specimens established that the prevalence of *Taenia* infection was not much different from that of the early 20th century Korean population. As many of taeniasis originally diagnosed as *Taenia saginata* in South Korea were revealed to be actually *Taenia asiatica*, which share a common intermediate host with *T. solium* (the pig), Joseon people must have ingested raw pork frequently. However, the current examination of extant Joseon documents revealed that the population ate significant amounts of beef even if the beef ban was enforced; and pork was not consumed as much as we thought. Considering the meat consumption pattern at that time, Joseon people should have been infected by *T. saginata* more frequently than *T. asiatica*. This may suggest a low prevalence of *T. saginata* metacestodes in cattle compared to that of *T. asiatica* metacestodes in pigs, possibly due to the traditional way of rearing pigs (using human feces). This letter gives us a chance to reconsider the existing preconception about parasitic infections in Korean history though we are still hard to accurately estimate the historical patterns of taeniasis at this stage.

Key words: *Taenia asiatica*, *Taenia saginata*, *Taenia solium*, pork, beef, Korea, Joseon

Human taeniasis are caused by the tapeworm species of *Taenia solium*, *Taenia asiatica*, or *Taenia saginata*. Among them, *T. asiatica* is mainly distributed in Asian countries, and is the dominant tapeworm species in South Korea [1,2]. Due to morphological similarity, *T. asiatica* has been confused with *T. saginata*, even by experienced parasitologists. Before the 2 species finally were revealed to be distinct from each other, Korea was known to be a *T. saginata*-dominant country [3].

However, many researchers pointed out that the information was not well matched with the dietary habit of the taeniasis patients in the country at that time. Korean *T. saginata* has been more frequently observed among people with a dietary history of ingesting raw pork than raw beef. This is interesting in that the intermediate host of *T. saginata* is not the pig, but the cattle [2,3]. This issue was finally solved when South Korean taeniasis originally diagnosed as *T. saginata* were revealed to be actually *T. asiatica*, which shares a common intermediate

host (the pig) with *T. solium* [3]. It is now clear why *T. saginata*-like parasites have been detected among raw-pork-eating South Koreans.

Over the course of the past decade, we have performed a series of paleoparasitological studies on the samples from mummies unearthed at the archaeological sites in South Korea [4,5]. With the information obtained, we recently have estimated the parasite-infection prevalence among the pre-modern Korean populations [6]. In our parasitological examinations of Joseon-period mummies (n=25), *Taenia* spp. eggs were discovered in 2 cases (GJ1-2 and Junggye). The prevalence of *Taenia* tapeworms among that Joseon population therefore was estimated to be about 8% (2/25) [6]. This result is comparable to the 1920s' Korean reports of taeniasis (6-16%) [3,7], but significantly higher than those reported in the 1960s-1970s' Korean populations (0.5-0.7%) [8-10].

Although we were able to estimate the prevalence of *Taenia* spp. in Joseon societies, the specific questions on taeniasis of the pre-modern Korean population remained. Were the Joseon people infected with human taeniasis in the same way as present-day individuals? Had they also been eating a lot of raw pork and thus been infected by *T. asiatica*? Had the prevalence of *T. saginata* and *T. asiatica* metacestodes high in cattle and

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pigs, respectively? Regarding these questions, the Joseon Kingdom's strict prohibition against beef eating (to promote the use of cattle in farming) has loomed large for investigators. If the beef ban was actually and strictly enforced in the Joseon period, it means that pork might have been consumed instead, becoming the main source of Joseon people's taeniasis. However, positing any exact *Taenia*-infection mechanism based on conventional research methodology is exceedingly difficult.

Looking for answers to paleoparasitological questions, we used to rely on extant historical records. Actually, over the past several years, we have introduced new historical research methodologies for obtaining more detailed information on the parasitism in Korean history. By such approaches, we have been able to uncover and confirm the concrete facts about the various forms of parasitisms prevailing among the Joseon population [11,12].

Taking the same tack, recently we have re-considered the detailed pre-20th century *Taenia* infection situation based on a search of the Joseon records of the national digital archive, the DB of Korean Classics (maintained by the Institute of Translation of Korean Classics; <http://db.itkc.or.kr/itkcdb/mainIndexIframe.jsp>). The Joseon documents retrieved by multiple keyword searches included the followings: *Joseonwangjo Silrok* (*The Annals of the Joseon Dynasty*), *Imhapilgi*, *Songjadaejeon*, *Gaksadeungrok*, *Shinjeung Donggukyeojiseungram*, *Ilsungrok*, *Seungjeongwon Ilgi* (*The Daily Records of the Royal Secretariat of Joseon Dynasty*), *Amseojib*, *Mihojib*, *Ojuyeonmunjangjeonsango*, *Sallymgeyongje*, *Haedongyeoksa*, *Gukjobogam*, and *Mokminsimseo*, among still others.

So, was our preconception of Joseon Dynasty beef consumption accurate? According to the records, the reality was somewhat different. Briefly, there definitely was a statute prohibiting beef eating. This notwithstanding, many historical records clearly indicate a habit of beef consumption among the Joseon people (Supplementary Data A-1 to A-11). Surprisingly, even in Old Seoul City (the Joseon capital), there were 23 official butcher shops where beef was sold (Supplementary Data B-1). Even more curiously, these shops could not meet the demand for meat, as there is documentary evidence of applications having been submitted to the government for permission to open additional shops in the city (Supplementary Data B-2 to B-5).

At least in principle, given that the beef consumption of the Kingdom was strictly controlled, it would be expected that the number of slaughtered cattle were kept to the minimum by

the government. However, illegal practices by slaughterhouses were rampant in the Kingdom. Indeed, far more cattle than officially allocated were killed for food (Supplementary Data C-1 to C-6). Additionally, throughout the kingdom, many individuals illicitly slaughtered cattle in order to sell meat on the black market. Even government officials, careful not to be caught by inspectors, were happily eating the beef (Supplementary Data D-1 to D-4).

According to a Joseon record, 'beef was piled up like a mountain' at the meat-selling shops (Supplementary Data A-4). Historical records estimated that by the 19th century, hundreds to thousands of cattle were being slaughtered per day nationwide (Supplementary Data A-8; A-10; C-4; C-6; D-1). Occasional crackdowns aside, the law prohibiting beef consumption in the Joseon Kingdom had virtually lapsed.

The popularity of beef in Joseon society is apparent in the main recipes that have been passed down to their posterity. As still enjoyed today, Joseon people preferred roasted beef dishes, such as *bulgogi* or boiled-beef soup like a *shinseonro*. We also note that *yukhoe* (beef sashimi) was a Joseon favorite as well (Supplementary Data E-1 to E-6). Considering that *yukhoe* is known to cause taeniasis today, the Joseon records lead us to suspect that people at the time contracted taeniasis in the same way (Supplementary Data F-1 to F-5).

Whereas beef seems to have been enthusiastically enjoyed by the Joseon people, pork was not consumed in nearly the same quantities. Actually, in Korean history, the archaeological evidence of domesticated pigs can be traced back as far as the Early Iron or Proto-Three-Kingdoms periods [13]. Although pork was consumed, hunted game animals were the key sources of protein at the time. In fact, even until the Three-Kingdoms period, most domesticated pigs were raised for special religious-ceremonial purposes [13].

The relative unpopularity of pork in Goryeo period (918-1392 CE) (Supplementary Data G-1 to G-3) would prevail into the early Joseon period (Supplementary Data H-1 and H-2). As for the reason, we were able to find documentary evidence in support of our hypothesis that the marginalization of pork in the Joseon diet was due simply to the exceeding popularity of beef. The low consumption of pork in fact was often noted in calls for its increased consumption (Supplementary Data H-3 and H-4).

Our hypothesis and related historical findings also are supported by archaeologists' reports on animal bones unearthed at excavation sites. Many cattle, horse, and dog bones have

Table 1. Animal bones collected in archaeological excavation sites of Joseon period

Archaeological site		Animal Bones ^a					
Province	Site name	Cattle	Horse	Pig	Water deer	Deer	Dog
Gyeonggi	Jongmyo Square [14]	31 (ND)	6 (ND)	1 (1)	-	1 (1)	1 (1)
	Yookcho Main Street [15]	24 (4)	6 (1)	-	-	-	4 (2)
Jeolla	Gangjin Castle [16]	163 (5)	10 (1)	-	-	-	21 (2)
	Yeosu Castle [17,18]	36 (ND)	1 (1)	-	-	12 (ND)	23 (ND)
Gyeongsang	Bangu-dong [19]	6 (ND)	16 (ND)	-	1 (1)	1 (1)	1 (1)
	Bangji-ri [20]	12 (ND)	2 (1)	-	-	1 (1)	6 (1)
	Bongwhang-dong [21]	29 (ND)	22 (10)	-	-	-	4 (2)

^aThe number in parenthesis indicates minimum number of individuals (MNI). ND, not determined.

been found, among which evidence, pig bones have been relatively few (Table 1) [14-21]. The Joseon people's great love of beef seems to have begun to change in the late stage of the Joseon period. In the 17th to 18th century records, official butchers' beef sales were curtailed by a sharp increase in pork consumption (Supplementary Data I-1 to I-3). Regardless, pork's emergence as a major staple of the Korean diet can be considered to be a relatively recent phenomenon.

In summary, concerning the question whether taeniasis of the pre-modern Korean population were infected by the same mechanism as seen in present-day individuals, the current historical report is somewhat meaningful to us. We note that pork was not consumed in Joseon society as much as we thought even if the beef ban was enforced at that time. Therefore, to accept a conjecture that *T. asiatica* infection was common in Joseon period as well, we should first admit that the infection among the people was the outcome despite the low possibility of pork ingestion during the period. This may suggest that the prevalence of *T. asiatica* metacestodes in pork was much higher than that of *T. saginata* metacestodes in beef. The possible reason may include the traditional way of rearing pigs (commonly using human feces), compared with that of rearing cattle (with fodder or forage and having low change to contact with human feces). This letter gives parasitologists a chance to reconsider the existing preconception about parasitic infections in Korean history, although it still remains difficult for us to accurately estimate the patterns at this stage.

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