Foodborne disease risk assessment at Kamp Heumensoord

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INTRODUCTION

During the annual International Four Day Marches Nijmegen, the Royal Netherlands Army (RNLA) sets up Kamp Heumensoord to accommodate around 6000 participating military personnel with approximately 30 different nationalities. The RNLA's facilities' core focus is maintaining and supporting battle strength and to reduce the possible risk factors that might compromise this. The standard food safety manual applied at this location describes the HACCP-based system in place, implemented to reduce the risk of food- or waterborne illness to a minimum.

Kamp Heumensoord functions similar to a temporary base. It offers facilities such as housing, sanitation, food and medical care. From a (veterinary) public health perspective the food and water safety are interesting aspects and could pose mild to more serious threats to the health of the military personnel, thus compromising battle strength.

In general, when providing meals in a professional setting (such as a restaurant or a canteen) applicable legislation provides guidelines and requirements for the complete production process. From farm to fork, every step is closely monitored and each manufacturer in this production chain has to comply with these legislative requirements. The statutory provisions that apply here are laid down partially in the European General Food Law (Regulation (EC) No 178/2002) and Commission Regulation (EC) No 2073/2005 on microbiological criteria for foodstuffs. In addition at national level, these provisions are elaborated upon in the Dutch "Warenwet" (Ministry of Health, Welfare and Sport) and its subsequent regulations "Warenwetregeling Hygiëne van levensmiddelen" and the "Warenwetregeling Bereiding en behandeling van levensmiddelen".

When assessing any foodborne disease risk a wide range of risk factors have to be taken into account. Two of the most relevant questions are: 1) what foods are served? and 2) how are these foods prepared? Subsequently, one must clarify to whom these foods are served and if any of all people consuming the foods belong to a specific higher risk group, the so-called YOPI's (the Young, Old, Pregnant and Immuno-compromised).

Food is meant to strengthen the military personnel and improve their health. Military personnel is sometimes considered to represent the "s" in YOPI's, (the s for soldiers), for their immense physical performances which often take place under harsh circumstances that can negatively influence their susceptibility to pathogens (i.e. immuno-compromised) (23). Within this research the particular group of military personnel of interest are also considered YOPI's. They are living with 6.000 people in a relatively small space, with one central kitchen in a temporary setup, while performing at high physical levels in hot weather. Especially YOPI's are more prone to fall ill from taking in microbiologically contaminated food (20). The risk for YOPI's is higher due to increased severity of the disease. For instance a *Salmonella* infection or *E.coli* infection in healthy people is unwanted and unpleasant, but most of the time cause transient illness without long-term consequences. YOPI's that are infected with *Salmonella* can develop complications such as endocarditis, polyarthritis or osteomyelitis. In even more severe cases, circulating endotoxins can also cause dehydration, kidney failure and heart failure, possibly leading to death. An infection with *E.coli* could, for YOPI's, could lead to development of the Haemolytic Uremic syndrome (HUS), especially in the young and the old people. HUS gives an acute inflammation and failure of the kidneys and anaemia (18,19, 20), with a high risk of mortality.

The focus of risk management lies on prevention of incidents. Assumptions are made based on hazard identification and analysis and risk assessments. Combining these two aspects will ensure that the predicted risk is as closely linked to reality as possible. But one has to bear in mind that only a theoretical assessment without factual data could result in a predicted relative risk that has no direct links to the actual situation

anymore. Evidently these methods are needed to develop a food producing process. In order to assess the validity of the risk management tools and measures within this process a quantitative microbiological analysis is indicated. This should provide a truthful answer to the most relevant question of all: Not to what relative risks the military personnel were exposed but: What is the absolute risk and did they actually suffer from foodborne illnesses?

The most relevant aspects for an RNLA kitchen at a temporary base like Kamp Heumensoord are full awareness of potential risks and assuring they are under control. Can a temporary base like Kamp Heumensoord during Summer days (daily temperature over 25 °C) (24) guarantee and see to it that the soldiers stay healthy thanks to the food and not despite of it or worse, suffer from foodborne illness?

The purpose of this study is to assess the foodborne disease risk of all military personnel who use the RNLA's kitchen at Kamp Heumensoord during the International Four Day Marches Nijmegen 2013. This risk assessment was done by evaluation of HACCP-implementation, general hygiene and microbiological analysis of one of the meals served during the event.

MATERIALS & METHODS

In order to assess the food and water safety at Kamp Heumensoord during the International Four Day Marches Nijmegen 2013, several aspects of food preparation and distribution were investigated. After a brief introduction the separate evaluations and assessments will be discussed in more detail.

First an assessment of the Hazard Analysis and Critical Control Point (HACCP)-protocol was conducted based on inspection of the documents in place, which consisted of the basic document that lays out the principles and exact description for every food serving facility of the Royal Netherlands Army.

Secondly, the implementation of the HACCP-system at the International Four Day Marches Nijmegen 2013 was evaluated by inspection of, e.g., the location, environment, work materials, work methods, personnel, flow of goods, food storage and food preparation. This inspection was done on Tuesday, July 16th , the first marching day, as a sample survey.

Subsequently the efficacy of the cleaning procedures were evaluated by determining the hygiene status for the kitchen and food distributing point at the start of the evening meal, using swabs and agar dip slides. This was also conducted on the first day of the marches.

Furthermore the microbiological risk of the food served was assessed by sampling several components of the meal. This was performed on the same day of the inspection and the kitchen hygiene assessment. On this day, the military personnel was served a beef soup, a beef burger, potato croquettes, a wok mix, and a pre-packed mixed salad (Smeding Groenten en Fruit, Sint Annaparochie). For dessert they could choose from fresh whole fruits and pre-packed dairy-based desserts.

All the samples taken were stored in a cooling bag during transport and were placed at the VPH Laboratory in a controlled cooling unit at 4 °C, until processing. Except for the agar dip slides which were placed in a stove at 37 °C.

Finally, reports were taken into account from the inspections and alternative laboratory tests that were conducted by, respectively, the food quality and hygiene inspectors of the Ministry of Defence and Culivers (Eindhoven), where the served food was originally prepared. These inspection reports included reports from multiple visits to Kamp Heumensoord on different days and also from the Four Day Marches events in 2012 and 2011.

KITCHEN HYGIENE ASSESSMENT

The kitchen hygiene assessment was done according to the standard procedures used by the laboratory of the Division Veterinary Public Health, Institute of Risk Assessment Sciences in Utrecht (VPH Laboratory). Sampled items, surfaces and foods were chosen based on a risk analysis and inspection of the routing and usage of the materials and work surfaces in the kitchen and buffet. Sample size depended not necessarily on aimed statistical power, but was adjusted to manageable workload for laboratory analysis.

In order to score the kitchen hygiene samples from working and service surfaces were taken using agar dip slides (3M agar dip slides) and swabs (NRS transwab). The agar dip slides are two sided agar slides, one side with a Plate Count Agar (PCA) (yellow) to score total aerobic count and one side with VRBG agar (red) to score enterobacteriaceae count. These slides can be used to sample smooth, dry and clean surfaces by slightly pressing the agar for ten seconds on to the surface. After holding it steadily for ten seconds the dip slide is turned so the other side can be pressed on to the surface. In total ten surfaces were sampled. At the VPH Laboratory the dip slides were incubated at 37 °C for 36 hours and then scored. Scoring was conducted

following the standard VPH Laboratory procedures; for the enterobacteriaceae count a zero tolerance was applied.

For the aerobic counts the scoring was based on the following categorization (Table 1) (22):

Number of colonies Per slide*	Per cm^2**	Class	Score
< 3	<1	0	Excellent
3 till 9	1 till 2	1	Good
10 till 29	2 till 5	2	Poor
30 till 90	6 till 20	3	Unsatisfactory
> 90	> 20	4	Bad
* for the agar dip slides, ** for the swabs			

TABLE 1 SCORING CATEGORIZATION AEROBIC COUNTS HYGIENE ASSESSEMENT

The swabs were dipped into the Neutralizing Rinse Solution (NRS) and then rolled in opposite direction of the sweeping three times one way and three times in perpendicular direction. The swab was then placed in the fluid holding casing and stored in the cooling unit overnight. In total ten swabs were taken. One swab was declared not usable for sampling due to a leaking storage container, leaving nine swabs for analysis at the VPH Laboratory. On day one at the VPH laboratory dilution series up to 10^{-4} were made and petrifilms (Aerobic Count Plates and Enterobacteriaceae Count Plates) were inoculated and then incubated respectively at 30 °C for 62 hours and at 37 °C for 24 hours before the plates were counted and scored (ISO 18593).

For both the agar dip slides and the swabs a zero tolerance for enterobacteriaceae count was applied. When cleaning protocols and procedures are carried out sufficiently, enterobacteriaceae are not to be found.

The elaborate and more precise work instructions for both the agar dip slides and the swabs are described in appendix I a 'Work Instructions'.

Microbiological Risk Assessment

The microbiological risk assessment consists of two aspects. Firstly, the temperatures of the different foods were measured by using a core thermometer at the distributing point, i.e. the buffet, in order to evaluate the regenerating and food handling process. Secondly, food samples were taken for further analyses on foodborne pathogens at the VPH Laboratory, which procedures are in accordance with available ISO standards.

Core Temperatures

Temperatures were measured using a core thermometer (Hanna Instruments, checktemp-1 C, the Netherlands). The probe was held in the food product at the distributing point until the reading stabilized and core temperature was recorded. At two different buffets the soup, the wok mix and the beef burgers were measured one till three times (2).

Food Samples

The samples were analysed at the VPH laboratory using standard procedures. A step-by-step description of these procedures is available in appendix I c 'Laboratory Test Procedures'.

Based on a risk analysis for the foods on the menu for Tuesday, July 16th, and acceptable Laboratory workload, a screening programme was drawn up (Table 2). Samples were taken from the Salad (n=4), the Wok mix (n=4) and the beef burger (n=4). The risk analysis was performed by desk-top research. First a list of pathogens with high number of reports per food component of the meal was drawn up. Second, a list of pathogens with highest incidence for foodborne illness in man was made. Then this prioritized list was combined with severity of the acquired disease. This led to a score per pathogen for all the different food components. Due to restricted capacity of the laboratory of choice, viruses were not included in the screening program. The final decision was made between the most relevant pathogens in general for this situation, i.e. regeneration, and workability was taken into account as well. A more elaborate report on this risk analysis is found in appendix I b 'Sampling Overview'.

	Salad	Wok mix	Beef burger
Aerobic count	✓	✓	✓
Enterobacteriaceae Count	✓	✓	✓
Salmonella	✓	✓	✓
Campylobacter		✓	✓
E.coli O157	✓	✓	✓
Clostridium perfringens	✓		
Staphylococcus aureus enterotoxins	✓	✓	✓
Listeria monocytogenes	✓	✓	

TABLE 2 SCREENING PROGRAM FOOD SAMPLES

For all the food samples 25 grams were weighed into a stomacher bag, supplemented with 225 mL buffered pepton water (BPW) creating a 10^{-1} dilution. After mixing for 90 seconds in the stomacher this dilution was used for most of the subsequent testing.

AEROBIC COUNT

To score aerobic counts for the salads, wok mixes and beef burgers Aerobic Count Plates petrifilms were inoculated and incubated for 62 hours at 30 °C. Subsequently, plates were counted and results evaluated using official European standards (Commission Regulation (EC) No 2073/2005, on microbiological criteria for foodstuffs).

ENTEROBACTERIACEAE COUNT

To score enterobacteriaceae counts for the salads, wok mixes and beef burgers, Enterobacteriaceae Count Plates petrifilms were inoculated and incubated for 24 hours at 37 °C, with subsequent results compared to the same European standards as mentioned previously.

SALMONELLA

All the food samples were tested for *Salmonella*. The before mentioned BPW solution in the stomacher bags is incubated for 24 hours at 37 °C. The day after Rappaport-Vassiliadis (RV) enrichment broth tubes and Muller Kaufmann Tetrathionate Novobiocin MKTN enrichment broth tubes are incubated for 24 hours, placed in respectively a water bath and a 37 °C stove. On day three for both of the tubes a brilliant green Agar (BGA) growth plate as well as a xylose lysine deoxycholate agar (XLD) growth plate were inoculated. The growth plates were inspected for characteristic colonies after a 24 hour incubation period at 37 °C. When these characteristic colonies were found they were used to incubate a series of three test tubes together with a positive control sample. This series of tubes consists of a triple-sugar-ironagar (TSI) tube, a ureum agar tube

and a lysine-decarboxylase medium (LDC) tube. If the reactions in these three tubes were evidently the same for the samples as for the positive control they would be defined as "suspected of *Salmonella*". Consequently, an agglutination test was performed. If the reactions in the three tubes was not evidently similar to the control tubes but also not clearly negative, a pure culture was made. This was done by incubating both the BGA growth plate as well as the XLD growth plate and testing was repeated from there according to the same procedures. In the end only a positive agglutination test from a pure culture would be qualified as *Salmonella* positive (ISO 6579). The decision making process is outlined in the decision tree shown in figure 1.

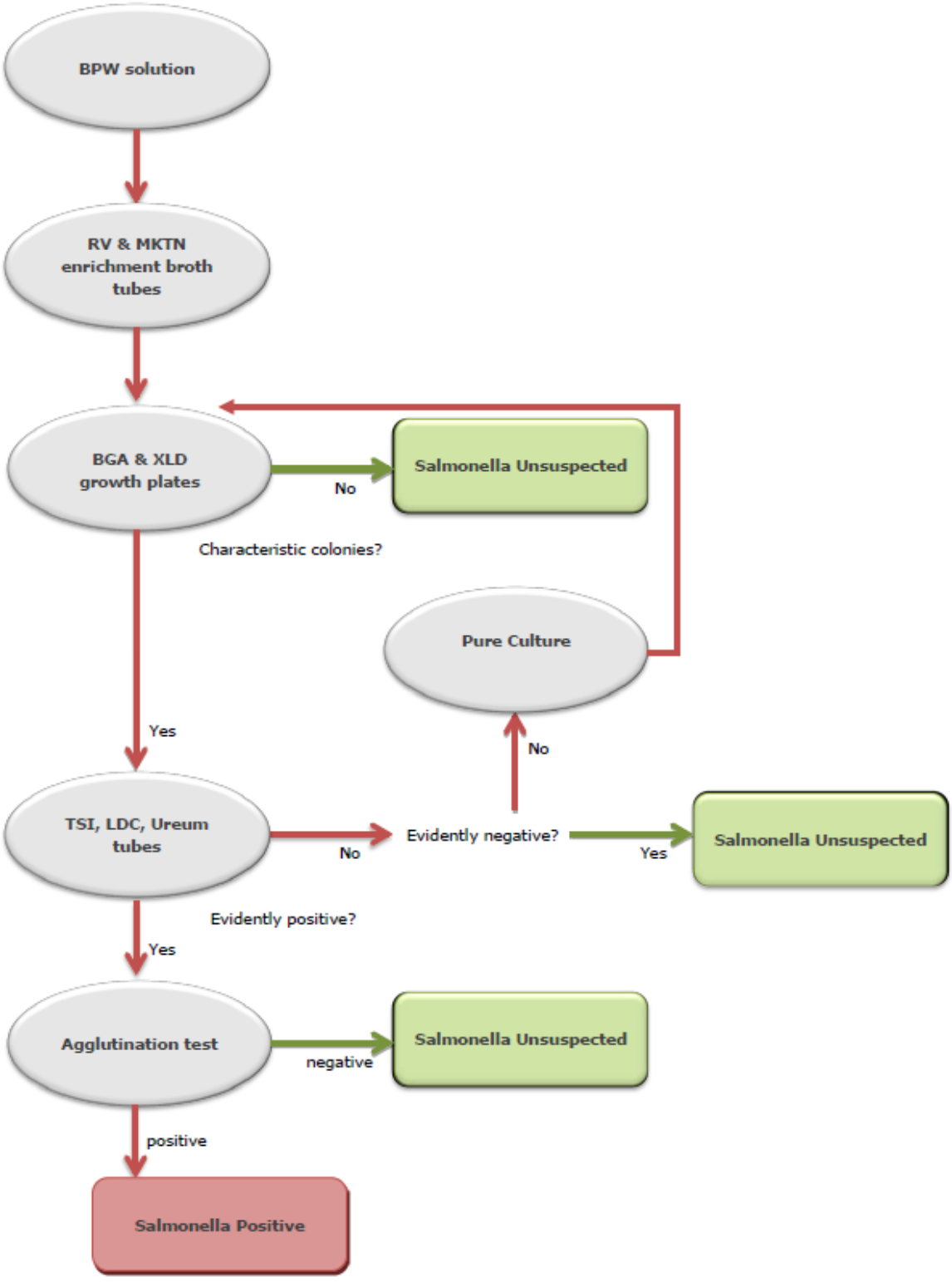

Figure 1 Decision tree for *Salmonella* testing

CAMPYLOBACTER

The wok mixes and beef burger samples were tested for *Campylobacter*. A cefoperazone charcoal deoxycholate broth (CCDB) tube were inoculated in a micro-aerobic environment in an anaerobic jar for 24 hours at 42 °C. Hereafter a cefoperazone charcoal deoxycholate agar (CCDA) plate was inoculated with this broth. The CCDA plates were again placed in anaerobic jars and incubated in a micro-aerobic environment for 48 hours at 37 °C. The CCDA plates were then inspected for specific colonies. If these specific colonies are found a hanging drop should be made where after an oxidase test and katalase test is performed. When these latter tests are both positive the sample will be qualified as *Campylobacter* positive (ISO 10272).

E.COLI O157

For all the food samples 25 grams were weighed into a stomacher bag, supplemented with 225 mL Modified Tryptone Soya Broth (MTSB) + novobiocine creating a 10^{-1} dilution. After mixing for 90 seconds in the stomacher, this dilution was incubated for 24 hours at 41 °C. At day two this dilution was transported into sterile tubes which were then heated in a 100°C water bath. Subsequently these tubes were brought back to room temperature by letting it rest outside the water bath. With help of the Transia card the samples are then tested for the presence of *E.coli* O157. Due to the test specifications any positive test would need further confirmation, for it might be a false positive outcome.

CLOSTRIDIUM PERFRINGENS

In order to test salad samples for contamination with *Clostridium perfringens* pour-plates have to be made. Into empty petri dishes 1 mL of either the 10^{-1}, 10^{-2} or 10^{-3} dilution was pipetted and *Clostridium perfringens* agar base with a TSC (Tryptose, Sulfite, D- Cycloserine) addition was added. The plates were then carefully swung, three times to the right, three times vertically and three times to the left to mix these two components together. After letting them rest to thicken, another layer of *Clostridium perfringens* agar base with a TSC addition was added. The thickened plates were thereafter incubated in an anaerobic environment for 24 hours at 37 °C. On day two these plates were inspected for classic black colonies, which, in case of appearance, would qualify the samples as positive for *Clostridium perfringens*.

STAPHYLOCOCCUS AUREUS ENTEROTOXINS

All the food samples were tested for presence of *Staphylococcus aureus* by inoculating *Staphylococcus* Expres Count System (STX) petrifilms. After incubating the petrifilms for 24 hours at 37 °C they were inspected for red violet colonies. Counting the number of colonies on this petrifilm would lead to a colony forming units (cfu) value per gram product. When *Staphylococcus aureus* is present in food in higher numbers than 10^5 cfu per gram, sufficient amounts of enterotoxins are produced to cause a food intoxication (15, 22).

LISTERIA MONOCYTOGENES

For both the salad samples and the wok mix samples a *Listeria* Selective Enrichment Broth (UVM) tube was inoculated and incubated at 30 °C for 24 hours. On day two this broth was used to inoculate a Fraser tube which was then incubated for 24 hours at 37 °C. On day three the tubes that had acquired a black colouring were used to inoculate *Listeria* growth plates which were then placed in a 37 °C stove for 24 hours. The *Listeria* growth plates were inspected for characteristic colonies on day three. When there would be any hesitance is a found colony was characteristic for *Listeria* this colony would be made into a pure culture. Finding characteristic colonies would qualify the sample as *Listeria* positive (ISO 11290).

KITCHEN HYGIENE ASSESSMENT

The hygiene assessment shows that halve of the sampled surfaces score excellent or good. The other halve score less good, i.e. poor, unsatisfactory or bad. Another remarkable feature is that the majority of the samples score either excellent (swabs) or the exact opposite, bad (Dip slides) (Figure 2). The surfaces are, with one exception, free from enterobacteriaceae.

The complete and detailed results oversights are found in appendices II a 'Lab results – Agar Dip slides' and b 'Lab results – Swabs'.

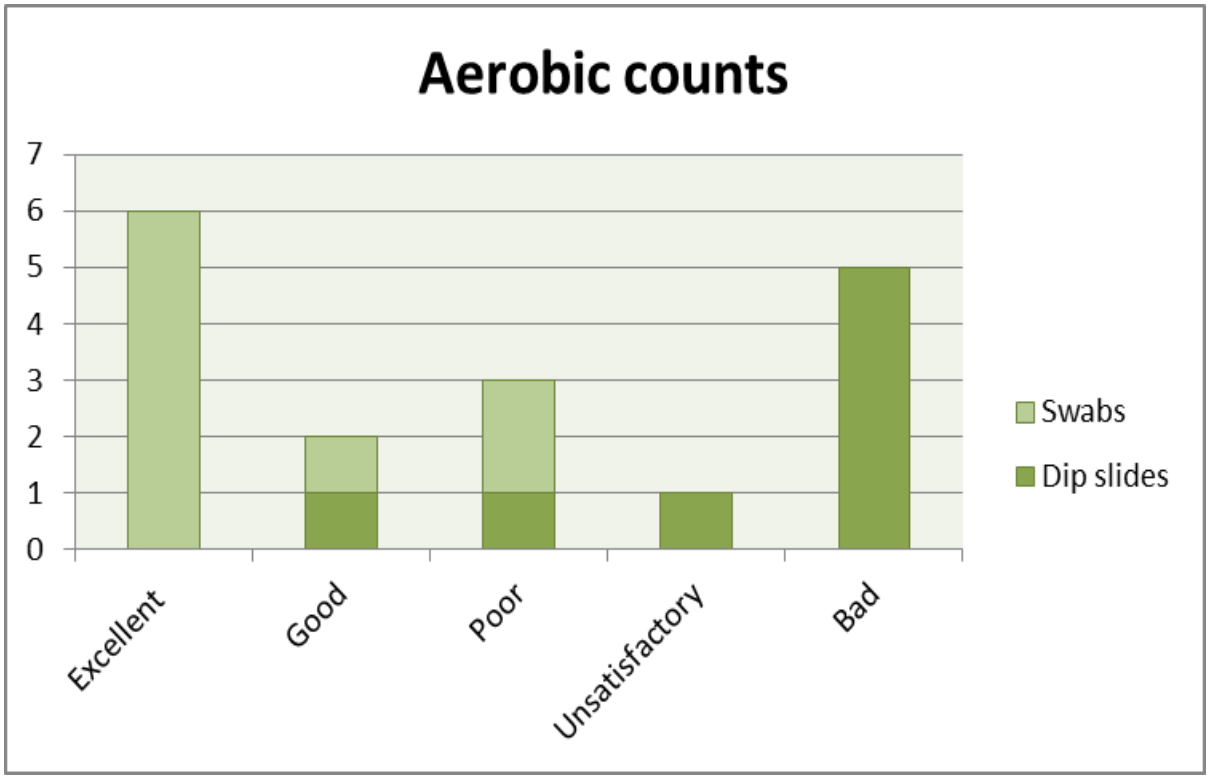

Figure 2 The scores for the aerobic counts of the agar dip slides and swabs

MICROBIOLOGICAL RISK ASSESSMENT

The results from the microbiological risk assessment are summarized below. The complete and detailed results overviews are found in appendix II c 'Lab results – Food Samples'.

CORE TEMPERATURES

The regenerating process was assessed by measurement of the core temperatures of the meal components. Results are listed below in table 3.

Food	Buffet	Temperature °C	Norm temperature °C (2)*
Wok mix	2	74,2-75,4	80
Wok mix	3	71-78,4	80
Beef soup	2	74,9	80
Beef soup	3	87	80
Beef burger	2	50,4-71,5	80
Beef burger	3	60,8-69,9	80
*at end of heating process. Within 1 hour heating up till 60 °C, further heating up till 80 °C (2).			

TABLE 3 RESULTS CORE TEMPERATURE MEASUREMENTS

FOOD SAMPLES

For the microbiological analysis of the food samples results are shown below (Table 4, 5 & 6).

SALAD

In the salad samples there were no maximum tolerable levels exceeded and no specific foodborne pathogens found (Table 4). The aerobic counts and enterobacterial counts all stayed within level of acceptance according European legislation (15, 16).

Salad		Maximum tolerable levels
Aerobic count	$2,86\text{-}3,96*10^7$	$<10^7$cfu/gr
Enterobacteriacae	$5,06\text{-}8,80*10^5$	$<10^6$cfu/gr
Salmonella	Not found	Absent in 25 gr
E.coli O157	Not found	$<10^3$cfu/gr
Clostridium perfringens	Not found	10^5cfu/gr
Staphylococcus aureus enterotoxins	Not found	<500 cfu/gr
Listeria monocytogenes	Not found	$<10^2$cfu/gr

TABLE 4 RESULTS MICROBIOLOGICAL ASSESSMENT SALADS

WOKMIX

In the wokmix samples there were no maximum tolerable levels exceeded and no specific foodborne pathogens found (Table 5).

Wok mix	
Aerobic count	0
Enterobacteriacae	0
Salmonella	Not found
Campylobacter	Not found
E.coli O157	Not found
Listeria monocytogenes	Not found

TABLE 5 RESULTS MICROBIOLOGICAL ASSESSMENT WOK MIXES

BEEF BURGER

In the beef burger samples there were no maximum tolerable levels exceeded and no specific foodborne pathogens found (Table 6).

Beef burger	
Aerobic count	0
Enterobacteriacae	0
Salmonella	Not found
Campylobacter	Not found
E.coli O157	Not found
Listeria monocytogenes	Not found

TABLE 6 RESULTS MICROBIOLOGICAL ASSESSMENT BEEF BURGERS

DISCUSSION

Interpretation of the results requires consideration of the following accompanying information: the review of the HACCP-protocol from the RNLA i.e. the food safety manual, the inspections at Culivers and Kamp Heumensoord and the reports from the inspections conducted by the food quality and hygiene inspectors of the Dutch Ministry of Defence. Besides inspections, measurements and sample taking were only performed on one day for one meal. Though the research in itself leads to quantitative results, it remains a sample survey where statistical power is debatable. Also the sampling plan is adjusted to logistical and practical considerations to obtain a workable plan besides scientific grounds. Any results derived and conclusions drawn from this research can be considered indicative for the International Four Day Marches Nijmegen. They cannot be interpreted as definitive since the research was limited to the evening meal of Tuesday 16th 2013.

Starting with the inspections there are some risk factors identified that could pose a threat to the microbial safety of the food thus possible impairment of the person's health.

Temporary employees recruited by the employment agency (Tempo Team) were not all fully aware of their responsibility towards food hygiene and more specific, food safety. Experience was not required and training was sparse. They were given instructions in writing from the employment agency and before the work shift started they were quickly briefed by the head of the kitchen from Paresto. During the work there was Paresto staff to oversee the whole process and support, guide and correct the temporary employees. This could not prevent the following behaviour to occur; jewellery such as rings, necklaces and earrings were not all removed, touching with gloved hands while standing at the buffet serving food of the face, hair and clothing, leaving the serving tray opened when there was no queue waiting to be served. This could in case of a possible contamination easily result in a fast spread of the agent and increase the risk of a foodborne illness (15) .

Furthermore, the garbage disposal was placed quite near to the kitchen and already on the second day of the marches a bad stench arose from it. Relocation was considered but no better suitable alternative was found.

Moreover, laboratory results from the kitchen hygiene samples showed that the environment at the start of the regenerating process was not as clean as could be expected. For the swabs it has to be considered that the aerobic counts were mostly estimates since there were only 1 or 2 colonies to be found on the petrifilm. Every number of colonies below 7 on a petrifilm is considered to be an estimate of lower than 7 and not reliable as an absolute value (22). This higher chance of coincidence with low counts is supported by our findings that for some samples 1 colony was found on the petrifilm from the 0 dilution, no colonies were found in the -1 dilution but then in the -2 dilution again, 1 colony was found. Not all samples were qualified as poor or bad, indicating that the cleaning procedure in itself is adequate. An incomplete execution however could account for the sampled places that scored badly. At the start of any cooking process, regenerating process and serving the environment should and could be clean.

The microbiological assessment was performed without screening for viral pathogens, such as norovirus, which are very frequent causes of foodborne disease (20).

Also, the microbiological assessment showed for the core temperatures several temperature measurements were below the standards laid down in the RNLA's food safety manual. However these standards are described as standards for temperature after heating. The temperature in this study was measured at serving at some time after direct heating. It cannot be concluded that prescribed temperatures were not reached, nor can it be confirmed. Though these measurements are inconclusive there are arguments to assume that the heating process was satisfactorily performed. For instance the microbiological analysis conducted by Culivers before transport to and delivery at Kamp Heumensoord showed higher aerobic counts and enterobacterial counts

than the samples taken during serving. Where Culivers found counts, which were still within the European safety margins, we did not count any, thus supporting the presumption of good heating process at Kamp Heumensoord. Though there is an estimated low microbiological risk there are also arguments for better heating of the meal components. First of all the served meal was almost cold by the time you sat down at the table to eat, negatively influencing taste perception. It is possible that later on during dinner this issue was solved by a shorter runtime due to higher number of incoming military personnel.

Additionally the microbiological assessment for the wok mix and the beef burgers showed no violation of the standards set in the European food law regulations. Also no specific food pathogens could be isolated from these samples.

The microbiological assessment of the samples taken from the pre-packed salads deserve more elaborate discussion. The role of fresh products, such as salad, in foodborne disease outbreaks has increasingly been investigated over the past years. *Salmonella* and *E.coli* O157 are strongly associated with produce-related outbreaks (7). We found aerobic counts that exceeded the upper limit while entorobacterial counts remained within the accepted margins. The aerobic counts were exceeded, slightly, but evidently. The enterobacterial counts make up 1,4 till 2,2 % of the aerobic counts which can be considered very small. The vast majority of the aerobic count can be attributed to other types of bacteria than enterobacteriaceae. Which agent or agents were responsible for these high aerobic counts cannot be concluded from this research since the tests for the specific pathogens relevant for salads (*Salmonella, E.coli* O157*, Clostridium perfringens, Staphylococcus aureus, Listeria monocytogenes*) all turned out negative, as these pathogens were not found in the samples. The increased aerobic counts could be due to bacterial growth during serving since the salads were not kept under cooled conditions at the buffet while the meal was served.

Overall, the overall foodborne disease risk for the military personnel was limited as there were no high-risk pathogens found in any of the foodstuffs served on that particular day and meal and there was no record from the Kamp's hospital of any food related illness. Relatively few military personnel treated at the Kamp's hospital came in with complaints related to the digestive system. Considering military personnel as YOPI's one would expect that if there was serious foodborne health risk, it would not have passed unnoticed.

CONCLUSIONS

Overall performance of the kitchen and the restaurant at Kamp Heumensoord at the International Four Day Marches Nijmegen 2013 can be considered sufficient, especially considering the dry, warm and dusty environmental circumstances. With few exceptions the kitchen and the restaurant are clean indicating that de cleaning protocol in place is valid but leaving some room for improvement for the execution of the cleaning protocol. Furthermore results show that the food served and tested on the second day of the marches was safe for consumption, although the salad might become a critical item when not properly cooled during storage and serving.

The overall foodborne disease risk at the time of sampling at Kamp Heumensoord can be considered at an acceptable low level.

RECOMMENDATIONS

At the time of inspection the garbage disposal was not fully closed off. Since a considerable amount of garbage is accumulated at this garbage disposal it could be beneficial to make more use of smaller containers, keeping the large garbage disposal closed until the smaller containers are emptied in the garbage disposal.

Cleaning protocols are to be followed more precise. These cleaning procedures can be checked relatively easy by using agar dip slides. One would only need a 37 °C stove. Besides agar dip slides, ATP measurements (Bioluminescence, BioControl Systems) could be used to perform a hygiene check right after cleaning (5). With these methods it will be possible to put in place corrective measures right away or after a day or two. Although there was no indication of military personnel falling ill due to the food served in the restaurant, insufficient hygiene remains a risk for contamination of the meals. In addition, more attention should be paid to the (temporary) employees in the kitchen and at the buffets in regards to the absence of all jewellery and correct use of hairnets and gloves. The employees could be screened on forehand according to the catering industry's standard program and be trained, instructed or corrected more and better.

It can also be recommended that the salads are kept cool during serving at the buffets. Due to the warm weather conditions during the International Four Day Marches Nijmegen the salads may increase rapidly, enabling bacterial growth. Alongside proper cooling, sufficient heating of the warm components of the meal is advised. Not only to reduce the chance of survival for pathogens but also for the taste perception.

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