HEALTH EFFECTS OF POTASSIUM CHLORATE-EXPOSED LONGAN DRYING FACTORY WORKERS

Phongtape Wiwatanadate, M.D.,1 Rangsan Voravong, M.D.,1 Tharntip Mahawana, M.P.H.,1 Danai Saraprug, M.P.H.2

1Department of Community Medicine, Faculty of Medicine, Chiang Mai University, Chiang Mai, 2Lumphun Provincial Public Health Office, Muang District, Lumphun, Thailand

Abstract This study was to investigate health effects of longan drying factory workers who were exposed to potassium chlorate or its metabolites. A descriptive design was applied to this study using interviewing questionnaires and recording forms. The samples comprised 199 workers working in various factories located in Muang district, Lumphun province. Seventy-nine percent of the workers were female, with a mean±SD age of 43.0±11.3 years. Sixty-four percent performed three steps of the longan drying process, i.e., peeling off, rinsing, and aligning longans in a tray in the mean daily working hours of 10.6±5.2. Sixty-eight percent did not wear gloves during their work. Sixty-six percent provided a history of allergy after working in the factories. Physical examination results showed lesions of occupation-related skin diseases on their hands and other parts of the body (21.0%). Laboratory investigations indicated that some workers were in the stage of anemia, leukocytosis, thrombocytopenia, and methemoglobin emai with percentages of 31.2%, 6.5%, 0.5%, and 35.2%, respectively. These values were statistically different from those of the normal population (p-value<0.05). The urinalysis also revealed hematuria and pyuria in 22.0% and 20.5% respectively, whereas, 7.5% had both hematuria and pyuria. The findings of this study suggested that longan drying factory workers might be at risk of potassium chlorate toxicities. Further analytical studies should be employed to prove this remark.

some experiments in animals showed that oral dose of 1,870 mg/kg killed 50% of experimental rats and it is, therefore, estimated that the lethal dose for human adults could be 15–35 grams. The effects of KClO₃ on health cited in the material safety data sheets could be categorized into two groups: acute and chronic. Acute toxicity could cause irritations of the respiratory tract (sore throat, coughing, etc.) after inhalation, gastrointestinal upsets (nausea, vomiting, diarrhea, abdominal pain, etc.) after ingestion, and redness and pain of the skin after physical contact. If KClO₃ is absorbed into the circulation at a high dose, it could cause hemolysis, methemoglobinemia, cyanosis, anuria, convulsions, and coma. It also may cause liver and kidney damage leading to death. If repeatedly exposed to KClO₃ in small amounts (chronic exposure), a person could develop loss of appetite and weight loss. However, no evidence of mutagenic effects or tumor promotion has been reported.

Materials and methods
A cross-sectional descriptive study was conducted. The target population was purposefully selected at Makhur Chae sub-district, Muang district, Lumphun province, because this area contains the most longan drying factories in the province. One hundred and ninety-nine subjects were randomly sampled from workers who had been exposed to longans that had been induced to blossom with KClO₃ for at least 3 months before data collection. All subjects were interviewed and records were made for their profiles, activity types and characteristics in the factory, health status, systematic history, systematic physical examination, and a laboratory investigation that included urinalysis, complete blood count (CBC), blood urea nitrogen (BUN), creatinine, and methemoglobin. The one-sample Student's t-test was used to examine the differences from the normal population.

Results
Profiles. The results showed that 79.4% were female with an age range of 10 to 78 years old and a mean±SD of 43.0±11.3 years. Their main occupation was agriculturists (57.3%). Regarding their activities in the factories, 63.8% performed three steps of the longan drying process, i.e., peeling off, rinsing, and aligning longans in a tray in the mean±SD daily working hours of 10.6±5.2. The range of the working period in the longan drying factories was 1–216 months with a mean±SD of 44.4±34.9 months. Regarding personal protection from occupational hazards, 68.3% had never worn gloves during their work. In view of health status, 78.4% had never smoked, whereas, those who had quit or were current smokers had a duration range for smoking of 1–50 years with a mean±SD of 24.5±15.0 years. Those with chronic illnesses were mostly related to the gastrointestinal system (17.1%). History of allergy was noted in 65.8%; among these, 80.2% could not specify the allergens. It was also found that 65.8% of the workers had allergic symptoms on their skin after working in the factories. Regarding systematic history taking, 21.0% of the workers had occupation-related symptoms on their hands and/or the skin on other parts of the body. It was confirmed by physical examinations that 53 workers (26.6%) had occupation-related lesions on their hands, e.g. acute and chronic eczema, tinea manus, tinea unguium, etc.

Laboratory Investigations. (Table 1.) CBC showed that 31.2% of the workers were anemic (hemoglobin < 12.0 gms%) with a hemoglobin mean±SD of 12.5±1.5 gm/dL, which was statistically different (p-value < 0.0001) from the mean of the normal northern rural population (13.6 gms%); 6.5% showed leukocytosis (leukocytes > 10,000 cells/mm³) with a mean leukocyte ±SD of 7,780.9±4,470.8 cells/mm³, which was statistically different (p-value = 0.0146) from the mean of a normal population (7,000 cells/mm³); and 0.5% had thrombocyto-
penia (platelet < 100,000 cells/mm³)\(^7\) with a mean±SD thrombocyte of 257,030.2±68,197.4 cells/mm³, which was statistically different (\(p\)-value < 0.0001) from the mean of a normal population (290,000 cells/mm³).\(^8\) Regarding blood chemistries, the results indicated that 35.2% showed methemoglobinemia (greater than 1.5%)\(^7\) with a mean±SD methemoglobin of 1.4±0.3%, which was statistically different (\(p\)-value < 0.0001) from the mean of the normal population (1.0%).\(^9\) The urinalysis revealed that 7.6% had urine sugar >1+; 11.1% had urine albumin >1+; 22.0% showed hematuria (RBC>5 cells/high power field); 20.5% showed pyuria (WBC > 5 cells/high power field); and 7.5% had both hematuria and pyuria.

**Discussion**

This epidemiological study in the longan drying factory showed that most workers had to perform various activities without wearing gloves to protect themselves from being exposed to KClO\(_3\) or residues. It might be that the workers have not been convinced enough about occupational health hazards despite the fact that most of them (65.8%) have a history of allergy after working in the factories. Also, 42 workers (21.0%) provided symptoms of occupation-related skin diseases, which were subsequently confirmed by physical examination, and 53 workers (26.6%) had a skin allergy (eczema or contact dermatitis) and/or fungal infection (tinea manus and onychomycosis). Moreover, laboratory investigation showed abnormalities that might be related to KClO\(_3\) toxicities, i.e. anemia, thrombocytopenia, leukocytosis, and methemoglobinemia, which were statistically different from the mean values of the normal population. This is due to the fact that KClO\(_3\) could cause hemolysis and damage to the platelets.\(^2,10\) The urinalysis also indicated that some workers had inflammation of the urinary tract, as 22.0% and 20.5% of them had hematuria and pyuria respectively. Since this study lacked a control group, it is unable to conclude that KClO\(_3\) is a causal agent. For example, thalassemia and G-6-PD deficiency must be ruled out as the causes of anemia, since these conditions are not uncommon in Thai people.

**Conclusion**

This research could be deemed as the first epidemiological study ever of the possible potassium chlorate effects on human health in longan drying factory workers. It has attempted to explore any abnormalities in workers who had been at risk of exposure to KClO\(_3\) or its metabolites from longans. Since the results suggest that the workers might be at risk from potassium chlorate toxicities, we recommended further analytical studies be employed to prove the above remarks. For the sake of occupational health and safety, all parties concerned should strengthen health education to convince these workers of the importance of personal protection.

**Acknowledgements**

Our deepest appreciation goes to the Thailand Research Fund for their financial support. We are grateful to all personnel at the Lumphun Provincial Public Health Office and Lumphun Hospital, sub-

---

**Table 1.** The laboratory investigation results of longan drying factory workers. (n=199 workers)

<table>
<thead>
<tr>
<th>Variables</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>SD</th>
<th>Test value a</th>
<th>(p)-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hemoglobin (gm/dL)</td>
<td>6.00</td>
<td>16.10</td>
<td>12.54</td>
<td>1.51</td>
<td>13.6</td>
<td>&lt;0.00001</td>
</tr>
<tr>
<td>Leukocyte Count (cells/mm(^3))</td>
<td>4,100.00</td>
<td>66,000.00</td>
<td>7,780.90</td>
<td>4,470.76</td>
<td>7,000.0</td>
<td>0.0146</td>
</tr>
<tr>
<td>Platelet (cells/mm(^3))</td>
<td>70000.00</td>
<td>507000.00</td>
<td>257030.15</td>
<td>68197.30</td>
<td>290,000.0</td>
<td>&lt;0.00001</td>
</tr>
<tr>
<td>Methemoglobin (%)</td>
<td>1.04</td>
<td>2.00</td>
<td>1.44</td>
<td>0.26</td>
<td>1.0</td>
<td>&lt;0.00001</td>
</tr>
</tbody>
</table>

a; the mean values of the normal population (see text for references)
district health personnel, heads of the village, and public health volunteers for their enthusiastic cooperation, coordination, and accommodation in making this research successful. Finally, all credit goes to all the longan drying factory workers in Muang district, Lamphun province who were the subjects of this study.

References

5. กนกนาถ ชูปญญา, คูมือการตรวจทางหองปฏิบัติการ เลม 2. กรุงเทพฯ: โรงพิมพเรือนแกวการพิมพ, 2528:1-102.
ผลการพบด้านสุขภาพในคนงานโรงอบล้างี่สัมผัสสารโปแตสเซียมคลอเรต
พงศเทพ วิชชวลติยา, น. ชัยวัฒน์ แสงกิจ, น. ศิริยา ภูริยา, ส.ม., 1
ดัชนี สุทธิภิรมย์, ส.ม., 2

1 ภาควิชาเวชศาสตร์ชุมชน คณะแพทยศาสตร์ มหาวิทยาลัยเชียงใหม่ จังหวัดเชียงใหม่
2 สถาบันสารสนเทศสุขภาพ จังหวัดลำพูน อ.เมือง จ.ลำพูน

บทคัดย่อ การศึกษาวิจัยครั้งนี้มีวัตถุประสงค์เพื่อศึกษาลักษณะทางคลินิก และโรคในคนงานโรงอบล้างี่สัมผัสสารโปแตสเซียมคลอเรตหรือสารตกค้างในกระบวนการปรุงผลิตภัณฑ์ การวิจัยเป็นการศึกษาข้อมูลวิเคราะห์ โดยใช้แบบสัมภาษณ์และแบบบันทึกข้อมูล กลุ่มตัวอย่างได้แก่คนงานโรงอบล้างี่จำนวน 199 คนที่ทำงานในโรงอบล้างี่หลายแห่งในอำเภอเมือง จังหวัดลำพูน ผลการศึกษาพบว่ากลุ่มตัวอย่างเป็นหญิงร้อยละ 79.4 อายุเฉลี่ย 43.0±11.3 ปี รายละ 63.8 ที่นั่งที่ 3 ขั้นตอนแรก แอนไธลีน และแอนไอซ์ไฮเดรนท์ ทำงานเฉลี่ยชั่วโมง 16.6±5.1 ชั่วโมง รายละ 69.3 ไม่สวมถุงมือในขณะทำงาน รายละ 65.8 ให้ประวัติมีอาการเพลียล้างี่ในโรงอบและเมล็ดของภาชนะที่มีเกลือหรือผลิตภัณฑ์ที่เกี่ยวข้องจากการทำงานรายละ 21.0 ผลการเข้าตรวจร่างกายที่กลุ่มตัวอย่างมีภาวะซีด เบอร์เลือดขาวสูง เรดเซลล์ที่ต่ำ และเมทีฮีโมโกลบินในเลือดสูง รายละ 31.2 และ 0.5 และ 35.2 ตามลำดับ ทั้งหมดมีค่าเลือดสูงกว่ามาตรฐานที่ระดับ 0.05 ผลการตรวจปัสสาวะพบมีเกลือเกลือและเมล็ดของผลิตภัณฑ์ในปัสสาวะมากกว่าปกติรายละ 22.0 และ 20.5 ตามลำดับ โดยที่รายละ 7.5 พบทั้งเม็ดเลือดแดงและเมล็ดของผลิตภัณฑ์ในปัสสาวะมากกว่าปกติ ผลการศึกษาครั้งนี้สรุปว่าคนงานในโรงอบล้างี่อาจได้รับการศึกษาเชิงวิเคราะห์ต่อไป ออกไข่ปัสสาวะ 2544:40(4):