

論文

製茶業工作場所現場物理與人因性危害調查研究

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摘要

茶葉是世界三大主要飲料之一，世界茶業市場正在不斷擴大，無論是茶葉產量，還是每人平均消費量，都在逐步增加。製茶業從前段到後段製程，其實包含了種茶、採茶與製茶等過程，全程從種植、採摘到製作茶葉，均有可能具潛在的職業傷病危害。本調查進行製茶全程現場訪視，調查其工作流程與分析潛在危害，同時辦理346份有效勞工安全衛生現況認知問卷調查並進行基本統計分析，以探討製茶業勞工職業危害因子與嚴重度分析，提供勞工與事業單位危害預防之參考。研究發現製茶業面臨嚴重缺工危機，其從業人員之年齡偏高，職場安全衛生意識偏弱，作業場所之安全衛生相關設施較為不足。採茶工和製茶工痠痛部位次序不同，未來宣教時應針對不同工作特性人員加強宣導不同項目。危害依序為疲勞、肌肉痠痛、熱危害分占53.5%、52.04%、49.5%。受訪製茶從業人員自認有不適症狀部位以腳踝/腳所占比例最高，為80.64%，其次依序為臀/大腿，占78.90%，上背73.41%，手肘71.64%，膝蓋63.85%，脖子60.90%，手/手腕60.08%，肩膀53.47%，下背/腰45.09%；因此未來應就上述幾種占高比例危害研擬危害防止或健康改善對策，以供製茶業勞工參考。此外，為解決製茶業長久以來人力缺口與專業不足，建議政府可透過政策導引，協助業者成立專業分工團隊，建立資訊溝通平台以吸引年輕人口投入。

關鍵字：製茶業、物理性危害、人因性危害、問卷調查

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前言

茶葉是世界三大主要飲料之一，依據統計全球茶產量自1963年破一百萬噸（102萬噸），到1983年突破二百萬噸（206萬噸），2001年突破三百萬噸（305.9萬噸），至2010年全球茶產量已高達416.2萬噸；台灣產製之茶葉主要區分有綠茶、烏龍茶及紅茶等三種，其中以部份發酵茶占最大宗[1]。據農委會茶葉改良場估計目前台灣茶園面積有21,554公頃，主要分佈以中部地區為主，約有6,000家的茶廠與大約50,000位以上的採/製茶工從事茶葉的製造作業，是一個相當大的勞動族群[2]。本調查所定義之製茶業從業人員為採茶工與製茶工兩種類別工作的總稱。

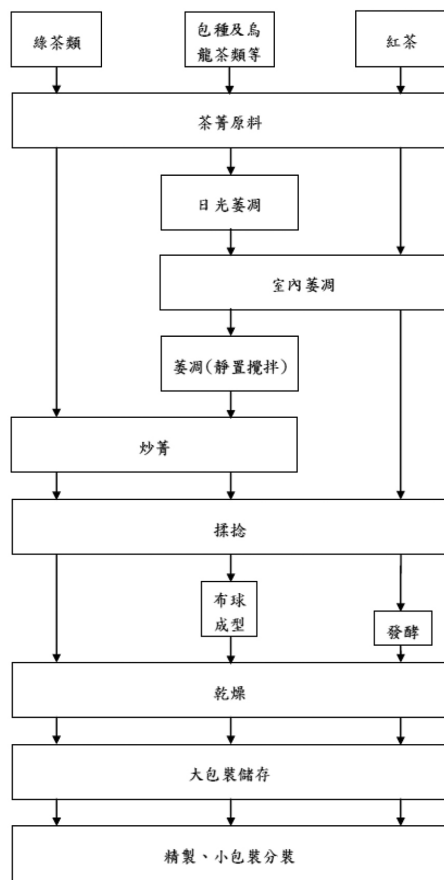


圖1 各種茶葉加工製作流程[2, 3]

圖1為目前在台灣之茶葉加工流程，分為綠茶、紅茶與包種及烏龍茶等類別，從茶菁原料的獲得一直到最後出貨期間所有必須進行之流程。其中綠茶類的製程因其不需經過發酵程序，所以較為簡單，由茶菁取得後，直接進入炒菁之工序，而後進行乾燥即可完成；包種及烏龍茶這種部份發酵茶工序較為繁複，須經萎凋與布球成型（烏龍）之程序，因此製作時需耗費較大量之時間與人力。

製茶相關行業是標準的勞力密集產業，茶葉採取勞力密集的加工，茶葉從採收開始，便需要大量人力，一年有六至七個月的茶葉採收時間，一共需好幾回，茶菁採收後，還要經過粗製、再製的程序，粗製經萎凋、攪拌、炒、揉、烘的階段，使茶發酵帶有香氣、乾燥便於保存，再製是使茶葉進一步發酵與乾燥，便於外銷市場，茶葉從粗製到再製的成本中，勞力所占的比例佔了50%以上。而製茶作業所延伸的工作相當繁多，若依工作項目區分，大致可分為「製茶工」與「採茶工」二種，目前的製茶工序分為日光萎凋、靜置攪拌、殺菁、揉捻等步驟，其中以揉捻是最辛苦的，因為揉捻的過程很費力氣，必須用力把布團揉緊；而採茶工序，分成人工手採與機採兩種，一般品質較佳的茶葉均以人工採摘方式處理，但須要耗費大量人力[4]。

根據製茶工會全國聯合會接到茶農報告統計資料顯示，98年度因採、製茶過程而受傷人數共9人；99年度共16人；100年度共13人。三年來共38人次。但據悉以上人數資料並不完整，因為有許多製茶從業人員不會上報受傷的人數，所以受傷人數應比統計資料更多，值得重視與研究。經現場訪視與訪談製茶業相關工作人員後，發現製茶業勞工在採製茶過程中可能發生之危害如下：

1. 肌肉骨骼傷害（人因性危害）

茶葉自採集、殺青、乾燥到包裝的製程都需要密集地使用人力工作，儘管現在有許多的機器已經被使用於製茶的過程當中，然而仍有許多部分是機器無法取代還必須使用人工去完成的，某些工作更是需要從事人員大量用手、手腕等部位用力反覆性的去操作，於是茶葉製造從事人員可能會有許多肌肉骨骼疾患的症狀如手腕隧道症候群、下背痛、肩頸酸痛、手部麻木無力等等被懷疑和職業特性有相關。

2. 農藥危害（化學性危害）

一般而言，農藥暴露發生的方式有三種主要的途徑：皮膚、吸入及口部攝食。通常大部份的職業性農藥暴露是經由皮膚途徑發生的，但是對某些種類的農藥（如燻蒸劑）及農藥噴灑的方式（如噴霧），吸入的途徑可能較為明顯。在製茶業中，使用人暴露之農藥不僅包括實際之噴藥農民，茶業製造工序中、搬運、包裝之作業人員，甚至包括了茶葉採收人員、溫室、倉庫及住家庭園之噴灑農藥等都有可能造成農藥暴露之風險。

3. 呼吸與過敏危害（生物性危害）[5]

茶葉在生產加工過程中，經抖篩、圓篩、風選等工序常會產生大量的茶塵微粒，當這些微粒進入呼吸道後可能藉由非特異性的刺激反應或免疫性的機轉對呼吸道造成影響[5]。

4. 機具操作危害（物理性危害）

由於茶廠使用的大型機具，在製茶過程都會存在一些危險，諸如：高溫灼傷、機械絞入…等等。對於高溫操作的炒菁機，針對機台高熱的周邊範圍，應有適當的防燙措施，防止

人員誤觸造成皮膚灼傷[4]。

目前，除茶塵對從業人員呼吸與過敏症狀的影響在國內外學者有比較多的研究與探討外[5-9]，其他對製茶業勞工於現場工作時極可能發生之危害，例如肌肉骨骼人因傷害、機具操作危害等，並未曾進行詳細之調查與分析，因此無法對製茶業勞工進行職業安全衛生認知輔導，以提高製茶業職業安全衛生文化與認知，且國內製茶業勞工多屬於學歷較低之中高齡族群勞工，對職業危害發生之防範大多不了解，因此，本調查希望透過較大規模之調查與現場訪談，主要分析國內製茶相關從業人員在工作時人因職業危害，最終以降低製茶業勞工危害為目的。

研究方法

1. 研究對象

本次調查對象主要為製茶業相關從業人員，包括採茶工及製茶工兩大工作類別，研究對象的選取為採立意抽樣之方式，根據國內茶區在各縣市之分佈情形與茶園茶廠及製茶業人數在各縣市所佔之比例，進行問卷調查與訪視抽樣，其樣本取樣來源分別為花蓮縣、南投縣、雲林縣、嘉義縣、台北線與苗栗縣茶園與茶廠，本研究共收集362份現場調查問卷，有效問卷為346份。

2. 問卷設計

本研究採用問卷包含三個部分。第一部分為個人基本資料，項目包括性別、服務機關、主要從事工作、年齡、身高、體重、從事此工作時間等；第二部分為工作描述，包括工作環境中的危害認知、安全防護與工作時姿勢或動作上的危害等；第三部分則為肌肉骨骼自覺不

適症狀問卷，此部分參考自勞工安全衛生研究所翻譯修訂出版之「北歐肌肉骨骼症狀問卷」[10]，主要以「身體圖」標示出身體的各個部位（包括脖子、肩膀、上背、下背/腰部、手肘、手/手腕、臀/大腿、膝蓋及腳踝/腳），詢問受訪者身體感覺不舒服的部位，並請受訪者就身體有出現不舒服感的部位自我評估不舒服感覺的時間、出現頻率、影響及不適程度等。

3. 問卷調查方法

問卷調查方式，採用現場調查方式進行，由施測人員在現場就問卷之題目與選項進行詢問，並做成紀錄。所有施測人員均經職前訓練與講座，以統一詢問與記錄之方式。

4. 資料處理與分析

依據本研究之目的，問卷調查所蒐集之資料，以SPSS（第20版）進行資料分析，進行一般性敘述性統計分析，分別探討影響製茶業工作者身體各部位別不適的危險因子。

結果與討論

1. 從業人員性別年齡分佈調查

本次研究調查受訪之346位製茶業從業人員有114人為男性（32.90%）、242人為女性（67.10%），如表1所示，因此女性所占比例為男性所占比例的2倍左右。若依其從事工作性質細分為採茶工與製茶工，本次受訪採茶工為235人（占總人數67.92%），製茶工111人（占總人數32.08%），因此本次問卷樣本以採茶工占多數，約為製茶工的2倍，主要因為採茶與製茶為一連續性過程，不管茶園面積大小，研究中發現採茶班需工較多，每次約在20人以上；然而製茶工則依製茶廠大小規模而

定，一般而言，小規模之家庭式製茶工廠之人力大約3至5人，而較大規模之製茶廠，人數大約在10人左右輪班作業，因此茶廠中製茶工所占比例較小。在採茶工性別方面，男性為38人，女性為197人，因此採茶工以女性居多，這也符合一般人之印象；在製茶工性別方面剛好相反，男性76人，女性為35人，以男性居多，人數約為女性2倍；大部分女性製茶工負責之項目為日光萎凋與室內萎凋，這是因為在製茶過程中，本製程為體力負荷相對小的製程，其他需較大體力勞動之製程，大都交由男性製茶工負責。研究製茶業勞工性別結果得知採茶與製茶在性別方面有相當之差異，推論這是因為製茶工為較需體力之勞動工作，例如搬運茶葉、揉茶等，體力之負荷量遠比採茶工需求高出甚多，因此，大部份均須由男性來擔任為宜。

依樣本次數分佈比例觀之，受訪之346位製茶從業人員為30歲以下的有25人（7.31%）、31歲至40歲的有34人（9.94%）、41歲至50歲的有70人（20.47%）、51歲至60歲的有103人（30.1%）、60歲以上則有110人（32.16%），遺漏值為4人（1.16%），因此若以50歲年齡為分野，製茶從業人員在50歲以上者共占62.3%，可知目前製茶業從業人員之年齡層偏高，這也部分顯示目前國內茶葉或農作行業所遭遇到的困境，年輕人寧願到工廠上班或擔任白領工作，以致於從事農作的年輕人口比例偏少，導致農作的技術傳承出現落差。若以從事工作內容區分，製茶工之年齡分配較為平均，大多集中在41歲至60歲之間，採茶工絕大多數在50歲以上，占67.09%。採茶工大都來自農村採茶班，平時由一位領班負責聯絡召集工作，除領班可能是茶場或茶園所有人外，其餘成員大部分由平時沒有固定工作之家庭主婦或老人

組成，很多都已經是阿嬤或阿公級的成員。而在製茶工部分，年齡在30歲以下的有14人、31歲至40歲的有12人、41至60歲占一半，有54人（50.0%），60歲以上則有18人；相較於採茶工，其高齡比例較小，這可能是因為製茶過程中需要的體力勞動相對較大，且須常熬夜製茶，工作時間連續且較長，因此年紀大者較不適合從事此工作所致。

表1 個人基本資料分佈表

變項	總計(346人)		採茶		製茶	
	人數	百分比(%)	人數	百分比(%)	人數	百分比(%)
班別						
固定班	272	78.61%	213	61.56%	59	17.05%
輪班	20	5.78%	5	1.45%	15	4.34%
不固定班	54	15.61%	17	4.91%	37	10.69%
性別						
男性	114	32.90%	38	16.17%	76	68.47%
女性	232	67.05%	197	83.83%	35	31.53%
年紀						
≤30	25	7.31%	11	4.70%	14	12.96%
31~40	34	9.94%	22	9.40%	12	11.11%
41~50	70	20.47%	44	18.80%	26	24.07%
51~60	103	30.12%	65	27.78%	38	35.19%
60以上	110	32.16%	92	39.32%	18	16.67%
遺漏4	4	1.20%				

2. 工作環境危害與環境狀態危害調查

表2顯示本次調查之製茶從業人員對工作危害之認知，依樣本次數分佈比例觀之，受訪之346位製茶從業人員認為環境中之肌肉痠痛、熱危害與疲勞很嚴重者分別占31.8%，30.1%，27.5%，幾乎是占調查人數之三分之一；認為肌肉痠痛、熱危害與疲勞嚴重者也分別占20.24%，19.4%，26.0%；若將認為很嚴重與嚴重者加總，前三名危害依序為疲勞、肌肉痠痛、熱危害分占53.5%、52.04%、49.5%，意即二分之一的接受調查人員均認為上述危害達嚴重以上程度，顯見其值得特別注意，且未來應優先考量提出解決方法。

若依工作類型將採茶工與製茶工分開，則

可看出不同類型的工作對工作環境危害類型的認知是否有所不同。有關製茶從業人員之熱危害部分，採茶工有92位感到很嚴重，43位感到嚴重，分別各占39.15%與18.3%，由此得知，採茶工在熱危害的部分是極需解決的問題；在製茶工方面，有12位感到很嚴重，24位感到嚴重，分別各占10.81%與21.62%，因此也有三分之一左右的製茶工認為工作環境中的熱危害是嚴重的。由以上數據可以得知，不管其工作型態是採茶工還是製茶工，熱的問題均是困擾的問題，未來應協助進行改善。

有關製茶從業人員之肌肉痠痛危害部分，採茶工有90位感到很嚴重，42位感到嚴重，分別各占38.30%與17.87%，幾乎與熱危害之大查結果相同，由此得知，採茶工在肌肉痠痛危害的部分也是極需解決的問題；在製茶工方面，有20位感到很嚴重，28位感到嚴重，分別各占18.02%與25.23%，明顯高於熱危害之數據，因此製茶工認為工作環境中的肌肉痠痛危害是嚴重的。由以上數據可以得知，不管其工作型態是採茶工還是製茶工，肌肉痠痛的問題均是困擾的問題，未來應協助進行改善。

在肌肉痠痛與疲勞部分為長時間重複性工作所導致；同樣可分採茶工與製茶工兩方面探討：在採茶工部分，一般來說大約在早上6點天初亮時即開始進行採茶工作，早上大約可採3至4次，下午大約可採2次，因此一天大約可採5至6次；採茶時必須長時間站立，彎腰或低頭，長時間背負採滿時可重達約10公斤的採茶簍，這可能是採茶工感覺肌肉痠痛與疲勞之主要原因；在製茶工部分肌肉痠痛與疲勞之原因可能是施力方式或姿勢不當所造成，因製茶工製茶時的揉捻過程很費力氣，工作人員必須用力把布團揉緊，因此，若用力不當可導致肌肉痠痛甚或受傷。

此外調查結果顯示滑倒危害在很嚴重與嚴重程度以上者均占21.7%，約為調查人數之五分之一，不管是採茶工還是製茶工，其看法也相當一致，因此滑倒危害也應值得注意。而滑倒在採茶工方面，主要來自於許多茶園位於陡斜的坡地，上下坡時容易滑倒，為茶園之地理環境所致；在製茶工方面，可能是因為製茶場所常有茶葉殘渣或茶粉散落在地上，導致地面較滑所致，且製茶工於工作期間，移動頻仍，因此增加工作時滑倒機率，所以應在勞工教育時對這些項目予以加強防範。

在機械傷害部分，採茶工方面，認為切割傷危害在嚴重以上者佔了27.24%，因此值得特別注意，據觀察切割傷主要應發生在採茶工作時所使用之銳利刀片切割傷，一般而言均不會非常嚴重，但仍應對這項目予以加強防範。

在噪音的部分，調查製茶工所得的數據在危害程度嚴重以上也達到20.73%，值得特別注意，據觀察主要應發生製茶場所因機器運轉所產生之巨大噪音所致，越多台機器進行運轉、製茶場所空間越小或採封閉式環境進行炒菁作業時，此危害更劇，未來如何對此方面進行改善值得探討。

表2 工作環境危害調查表(N=346)

危害 類型	工作 類型	很嚴重	嚴重	還好 (人數/百分比)	輕微	影響
滑倒		36 (10.40%)	39 (11.3%)	89 (25.7%)	44 (12.7%)	138 (39.9%)
	採茶	23(9.79%)	28(11.9%)	59(25.11%)	28(11.91%)	97(41.28%)
	製茶	13(11.71%)	11(9.91%)	30(27.03%)	16(14.41%)	41(36.94%)
油煙		12 (3.5%)	13 (3.8%)	24 (6.9%)	19 (5.5%)	278 (80.3%)
	採茶	6(2.55%)	2(0.85%)	9(3.83%)	5(2.13%)	213(90.64%)
	製茶	6(5.41%)	11(9.91%)	15(13.51%)	14(12.61%)	65(58.56%)
噪音		12 (3.5%)	22 (6.4%)	51 (14.7%)	15 (4.3%)	246 (71.1%)
	採茶	6(2.55%)	5(2.13%)	12(5.11%)	6(2.55%)	206(87.66%)
	製茶	6(5.41%)	17(15.32%)	39(35.14%)	9(8.11%)	40(36.04%)
熱		104 (30.1%)	67 (19.4%)	104 (30.1%)	10 (2.9%)	61 (17.6%)
	採茶	92(39.15%)	43(18.30%)	62(26.38%)	7(2.98%)	31(13.19%)
	製茶	12(10.81%)	24(21.62%)	42(37.84%)	3(2.70%)	30(27.03%)
燒燙傷		28 (8.1%)	20 (5.8%)	56 (16.2%)	18 (5.2%)	224 (64.7%)
	採茶	20(8.51%)	10(4.26%)	26(11.06%)	8(3.40%)	171(72.77%)
	製茶	8(7.21%)	10(9.01%)	30(27.03%)	10(9.01%)	53(47.75%)

危害 類型	工作 類型	很嚴重	嚴重	還好 (人數/百分比)	輕微	影響
切割傷		36 (10.42%)	39 (11.3%)	125 (36.1%)	42 (12.1%)	104 (30.1%)
	採茶	30(12.77%)	34(14.47%)	91(38.72%)	31(13.19%)	49(20.85%)
	製茶	6(5.41%)	5(4.50%)	34(30.63%)	11(9.91%)	55(49.55%)
肌肉 酸痛		110 (31.8%)	70 (20.24%)	98 (28.3%)	20 (5.8%)	48 (13.9%)
	採茶	90(38.30%)	42(17.87%)	68(28.94%)	12(5.11%)	23(9.79%)
	製茶	20(18.02%)	28(25.23%)	30(27.03%)	8(7.21%)	25(22.52%)
疲勞		95 (27.5%)	90 (26.0%)	105 (30.3%)	16 (4.6%)	40 (11.6%)
	採茶	15(13.51%)	27(24.32%)	43(38.74%)	10(4.26%)	20(8.51%)
	製茶	80(34.04%)	63(26.81%)	62(26.38%)	6(5.41%)	20(18.02%)
空間 狹小		7 (2.0%)	15 (4.3%)	73 (21.1%)	13 (3.8%)	238 (68.8%)
	採茶	6(2.55%)	8(3.40%)	25(10.64%)	7(2.98%)	189(80.43%)
	製茶	1(0.90%)	7(6.31%)	48(43.24%)	6(5.41%)	49(44.14%)

3. 職業災害安全防護措施實施程度調查

依樣本次數分佈比例觀之，受訪之346位製茶從業人員就調查項目而言，認為安全防護措施實施程度好以上占175人，占50.6%，認為不好以下者僅為22人，占3.36%，詳見表3。雖然調查結果顯示大部分的製茶從業人員認為工作場所的安全防護措施實施程度好，但是現場訪視時卻發現其實大部分的工作場所並沒有設置職業災害防護措施。以本次研究調查的茶園為例，位於坡地的茶園並沒有提供良好的安全防護措施，如隔欄、上下坡扶手、品質較好的防滑階梯等以防止採茶工在茶園的滑倒，另外載運工具之安全性也不佳，噴農藥時也沒有提供安全裝備，如呼吸防護具等。又以製茶廠為例，通風是否良好、是否有預防吸入茶塵，轉動機器之運作是否有防夾、安全防護或連鎖等安全裝置等在現場訪視時均未見。在人員運送方面，交通安全較不受到重視，常見一小貨車大約載送20~30人，擁擠且沒有安全帶，大部分僅在上方有簡易安全拉環或是長板凳上有一條繩子繫住，因此一旦發生交通事故，對乘坐車上從業人員的危險性相當大。因此由本調查顯然可以看出大部分的製茶從業人員在安全衛生的認知方面仍有不足，有待各方面宣導加強。

表3 職業災害安全防護措施實施程度調查表

重視度	總計(346人)		採茶		製茶	
	人數	百分比(%)	人數	百分比(%)	人數	百分比(%)
很好	42	12.14	25	7.23	17	4.91
好	133	38.44	78	22.54	55	15.9
普通	143	41.33	114	32.95	29	8.38
不好	10	2.89	8	2.31	2	0.58
很不好	1	0.29	1	0.29	0	0
不需要	11	3.18	4	1.16	7	2.02
不知道	6	1.73	5	1.45	1	0.29

4. 工作姿勢與動作上不適感調查

在工作姿勢或動作上，本次研究調查了10個項目，研究中發現有不適感最高的是久站，172人占49.7%，其次是手部反覆動作122人占35.4%，再來是姿勢不自然114人占33.0%，以上三項均有三分之一以上的受訪者認為在工作時有不適感，其他搬運重物的不適感亦有81人占23.4%，此四項均是未來在工作姿勢或動作上應提出改善方法，以減低從業人員不適感的重要項目。詳見表4。

表4 工作時身體姿勢或動作上不適感調查表

部位	有不舒服	
	人數	百分比
全身振動	24	6.9%
使用手部振動工具	23	6.6%
手部反覆	122	35.4%
使用重的手工具	27	7.8%
搬運重物	81	23.4%
姿勢不自然	114	33.0%
久站或走動	172	49.7%
皮膚接觸物	50	15.0%
作業速度	10	2.9%
台椅高度不適	48	13.9%

5. 肌肉骨骼傷痛症狀調查

依本次研究調查之9個部位，以所得樣本次數分佈比例觀之，如表5所示，受訪之346位製茶從業人員就調查項目而言，自認有身體部位有症狀以腳踝/腳所占比例最高，為80.64%，其次依序為臀/大腿，占78.90%，上

背73.41%，手肘71.64%，膝蓋63.85%，脖子60.9%，手/手腕60.08%，肩膀53.47%，下背/腰45.09%。採茶工和製茶工痠痛部位亦有部分不同，對採茶工而言，以腳/腳踝比例最高，臀/大腿、上背與手肘疼痛比例亦很高；但對製茶工而言，依序臀/大腿、腳/腳踝、手/手腕、膝蓋。由以上數字可以推論，採茶工因必須長時間站立或彎腰，可能是造成下肢痠痛的主因，另外，採茶工上背痠痛之可能原因是因為需長時間揹負採茶簍所致；而製茶工可能因為需搬運沉重之茶葉包而造成手/手腕與膝蓋與痠痛所致。

表5 肌肉骨骼傷痛症狀調查表

部位	總計		採茶		製茶	
	有無症狀	百分比(%)	人數	百分比(%)	人數	百分比(%)
脖子						
有痠痛	210	60.69%	142	41.04%	68	19.65%
無痠痛	136	39.31%	93	26.88%	43	12.43%
肩膀						
有痠痛	185	53.47%	124	35.84%	61	17.63%
無痠痛	161	46.53%	111	32.08%	50	14.45%
上背						
有痠痛	254	73.41%	169	48.84%	85	24.57%
無痠痛	92	26.59%	66	19.08%	26	7.51%
手肘						
有痠痛	248	71.68%	166	47.98%	82	23.70%
無痠痛	98	28.32%	69	19.94%	29	8.38%
下背/腰						
有痠痛	156	45.09%	93	26.88%	63	18.21%
無痠痛	190	54.91%	142	41.04%	48	13.87%
手/手腕						
有痠痛	239	60.08%	150	43.35%	89	25.72%
無痠痛	107	30.92%	85	24.57%	22	6.36%
臀/大腿						
有痠痛	273	78.90%	175	50.58%	98	28.32%
無痠痛	73	21.10%	60	17.34%	13	3.76%
膝蓋						
有痠痛	221	63.87%	133	38.44%	88	25.43%
無痠痛	125	36.13%	102	29.48%	23	6.65%
腳踝/腳						
有痠痛	279	80.64%	181	52.31%	98	28.32%
無痠痛	67	19.36%	54	15.61%	13	3.76%

6. 製茶業從業人力缺工問題與解決

國內之茶農基本上均屬於小農經營之型

態，目前製茶業因就業較不穩定，經濟保障不足，農務工作又辛苦，從業人員大多為年齡偏高之臨時人力或外配、外勞等外來弱勢人口，導致對工作場所安全衛生認知缺乏，專業訓練也不足，成為勞安隱憂。另外本國年輕人口不肯投入相關行業中，待有豐富經驗之勞工逐漸凋零後，未來製茶業之傳承將面臨困境，因此需政府在政策上給予支持，協助製茶業人才之培育與傳承。對於長久以來製茶業從業人力缺口與專業不足及傳承之問題，本研究建議政府可思考對採茶工與製茶工兩種成立專業團隊來協助解決相關問題，例如可透過政府補助、職業專業技能訓練、建立資訊虛擬平台進行交流、溝通、組織與媒合等，訓練有意願從事製茶業工作者具有多種園藝作業技能（耕種、養護、採收、製造），成立採收專業隊或茶（葉）業專業隊，提倡專業包工進行，例如稻穀業專業機械收割團隊。如此一來，透過釋放與擴大經濟誘因，方可吸引國內年輕人願意投入製茶相關行業中。

結論與建議

本研究就製茶業從業人員進行調查問卷，有效問卷共346份，以了解製茶業從業人員於工作場所之職業危害項目，以供未來提出改善之道。本研究就問卷調查結果與深度訪談結果可以看出下列事項：

1. 茶葉為我國四大輸出農產品之一，占有重要地位，因目前製茶業勞工年齡偏高，學歷較低，年輕人較不願加入，因此待有豐富經驗之勞工將逐漸凋零後，未來製茶業不但面臨缺工危機，且其技術傳承將面臨困境，相關農政單位應及早研擬對策以保台灣茶業之永續發展。
2. 建議政府可思考跨部會對採茶與製茶成立

專業團隊來協助解決相關問題，例如結合農委會與勞動部進行職業專業技能訓練，訓練有意願從事製茶業工作者具有多種園藝作業技能（耕種、養護、採收、製造），成立採收專業隊或茶（葉）業專業隊，提倡專業包工進行；此外亦應建立資訊平台、協助茶農組織與媒合；另外勞動部亦應介入，針對製茶業勞工之安全衛生的認知方面仍有不足部分進行擴大宣教，以防止職業災害。

3. 製茶工之工時較長，大部分時間要連續工作，有時會連續工作超過10小時以上或夜間也持續進行，因此長時間工作有可能導致身心狀態之不適。
4. 受訪之346位製茶從業人員認為環境中之肌肉痠痛、熱危害與疲勞很嚴重者分別占31.8%，30.1%，27.5%，幾乎是占調查人數之三分之一。認為肌肉痠痛、熱危害與疲勞嚴重者也分別占20.24%，19.4%，26.0%；若將認為很嚴重與嚴重者加總，前三名危害依序為疲勞、肌肉痠痛、熱危害分占53.5%、52.04%、49.5%，意即二分之一的接受調查人員均認為上述危害達嚴重以上程度，顯見其值得特別注意。
5. 研究中發現有工作不適感最高的是久站，172人占49.7%，其次是手部反覆122人占35.4%，再來是姿勢不自然114人占33.0%，以上三項均有三分之一以上的受訪者認為在工作時有不適感，值得特別注意，其他搬運重物的不適感亦有81人占23.4%。
6. 受訪之346位製茶從業人員自認有身體部位有症狀以腳踝/腳所占比例最高，為80.64%，其次依序為臀/大腿，占78.90%，上背73.41%，手肘71.64%，膝蓋

63.85%，脖子60.9%，手/手腕60.08%，肩膀53.47%，下背/腰45.09%。

7. 本研究調查顯示肌肉痠痛、熱危害、疲勞、滑倒、切割傷為製茶業勞工較嚴重之危害，建議未來應對此方面進行改善、研擬改善計畫與提出解決方案，以造福製茶業勞工。
8. 本研究調查顯示製茶業勞工對職業災害防止之教育訓練需求甚為殷切，建議政府相關單位應增加勞工安全教育相關經費，並鼓勵各行業積極申請辦理相關之宣導會，邀請專家學者與從業勞工座談，以提出適當且可行之改善方案。

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Research Articles

Investigation of Physical and Ergonomic Hazards in Tea Manufacturing Industries

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Abstract

Tea is one of the most popular three beverages all over the world. The total production quantity or the average personal consumption of tea increases gradually nowadays, according to the international statistics from the United Nations. In Taiwan, there exist statistically about 6,000 tea manufacturing factories, resulting in over 50,000 workers of the total labor population in the tea manufacturing industry. However, most of the tea workers do not have only the concept of occupational health and safety, but also the knowledge of self-protection in the work.

All the tea manufacturing processes, including tea plantation, tea plucking, tea processing procedures and so on are subjected to the Taiwan Labor Safety and Health Act. Workers in the tea manufacturing industry are likely exposed to a variety of occupational health and safety hazards, including pesticides exposure, hand plucking, high-temperature and mechanical cutting and vibration injuries, ergonomic hazards, muscle skeleton disorder, and so on. Therefore, investigation of the occupational hazards for the tea manufacturing worker is important and valuable.

We have basically investigated the potential physical and ergonomic hazards factors and analyze the severity in the tea manufacturing processes by finishing 32 spot coverage and 346 questionnaire surveys.

The finding indicates that the percentages of tiredness, muscle skeleton ache and disorder, hot hazard are 53.5%, 52.04% and 49.5%, respectively. The top three disorders of muscle skeleton follow the order: malleolus (80.64%)> buttocks (78.9%)> upper dorsum (73.41%).

Keywords: Tea manufacturing industry, Physical hazard, Ergonomic hazard, Questionnaire survey

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Introduction

Tea is one of the three most common beverages in the world. According to statistics, tea production was over 1 million (1.02 million) tons in 1963, over 2 million (2.06) tons in 1983, and over 3 million (3.059) tons in 2001, and recently reached 4.162 million tons in 2010. Tea in Taiwan is divided into three major categories: green tea, oolong tea, and black tea. Semi-fermented tea is the most common variety [1]. Estimated by the Tea Research and Extension Station of the Council of Agriculture, the total area of tea farms is currently 21,554 hectares. Tea Research and Extension Stations are mainly located in central Taiwan. About 6,000 tea farms and more than 50,000 tea-picking/tea-processing workers are involved in the tea-processing industry, and they have become a huge workforce [2]. The “tea-processing employee” referred to in our research includes both tea-picking workers and tea-processing workers.

Figure 1 shows the current methods of tea processing in Taiwan, including all necessary procedures, from receiving fresh tea leaves to final packaging. Methods vary according to the category of tea, such as green tea, black tea, and pouchong/oolong. The green tea process is easier since it does not need fermentation. After fresh tea leaves arrive, they directly begin the panning procedure and then drying. As for semi-oxidized teas, like pouchong and oolong, the process is more complicated since they require wilting and ball rolling. Therefore, the whole production is more laborious and time-consuming.

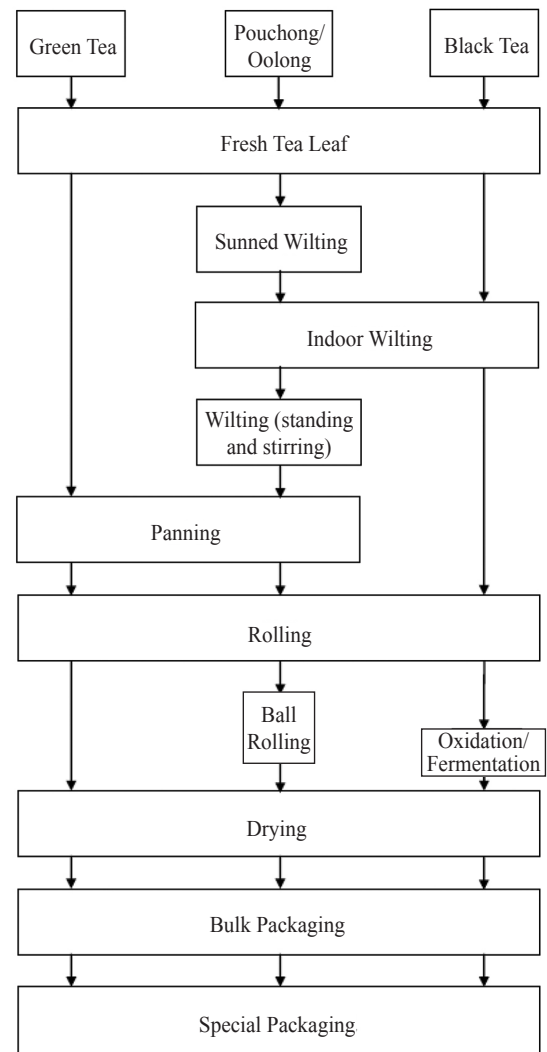


Figure 1 Processing procedures of all types of teas [2,3].

Industries related to tea processing are standard labor-intensive processing industries. Starting from the tea plucking, this industry requires large amounts of labor. Each year, there are six to seven months of plucking, so many plucking events are needed. After the plucking, other procedures, such as the primary process and the refining process, take place. The primary process includes wilting, stirring, panning, rolling, and drying to oxidize fragrant tea leaves and to

dry them for storage. The refining process further oxidizes and dries tea leaves for export sales. Labor costs account for more than 50% of tea processing costs, from the primary process to the refining process. Many jobs derived from tea processing can be divided into two categories: tea-processing workers and tea-plucking workers. Current tea processing procedures include sunned wilting, standing, stirring, and rolling. Among these, rolling is the most difficult because this procedure takes considerable effort to form tea leaves into strips. The plucking procedure can be completed either by hand or by machine. In general, teas with better quality are processed by hand, but take much more effort [4].

According to the statistics that the Taiwan Union of Tea has received from tea farmers, nine people were injured due to tea plucking and processing in 2009, 16 people in 2010, and 13 people in 2013, for a total of 38 injured individuals over three years. However, the above statistics are not complete since many processing employees did not report their injury incidents. The actual number of injured people is most likely more than what is reflected in the statistics, making it a subject worthy of attention and research. After visiting and interviewing employees related to the tea process, we found that the potential hazards that could occur during tea processing are as follows:

1. Musculoskeletal Disorder (Ergonomic Hazards)

From plucking, fixation, and drying to packaging, all these procedures require large amounts of labor. Even though many kinds of

machines are widely used in tea-processing procedures, many procedures cannot be replaced by machines and still require manual labor. Some tasks have to be repeatedly performed with the hands or wrists. Therefore, tea-processing workers may suffer from a variety of musculoskeletal disorders that are considered to be related to the properties of this industry, such as carpal tunnel syndrome, lower back pain, shoulder and neck pain, and numbness and muscle weakness in the hands.

2. Health Hazards of Pesticides (Chemical Hazards)

In general, people can be exposed to pesticides through three major pathways: dermal exposure, inhalation, and ingestion. Occupational pesticide exposure is usually dermal exposure. However, for some pesticides, such as fumigants, inhalation is the most likely exposure pathway. During the tea-processing industry, workers exposed to pesticides include not only those who actually spray pesticides and production, moving, shipping, and packaging employees, but also plucking workers and people in the greenhouse, storage area, house, and yard where the pesticides are sprayed.

3. Inhalation and Allergy Hazards (Biological Hazards)[5]

During tea processing, significant amounts of tea dust and microparticles will be produced due to shaking sifting, rotary sifting, and wind sifting. When these microparticles enter the respiratory tract, they will affect the respiratory tract through nonspecific stimulation or immune mechanisms [5].

4. Hazard of Equipment Operation (Physical Hazards)

Due to the use of heavy equipment on the tea farm, certain hazards may occur during tea processing, such as thermal burns, mechanical entanglement, and so on. Due to the high temperatures surrounding the equipment, appropriate measures are required to prevent people from getting burns [4].

Currently, many studies regarding the effects of tea dust on the respiratory system and allergies have been carried out both in Taiwan and overseas[5-9]. However, other research about potential occupational hazards that may occur on site are seldom investigated and analyzed, such as ergonomic hazards of musculoskeletal disorders, hazards of equipment operation, etc. Therefore, occupational safety and health guidance cannot properly be introduced to tea processing employees to improve the knowledge of occupational safety and health in the tea-processing industry. Furthermore, most tea-processing employees are not well educated and are middle-aged/elderly and thus do not understand much about preventing occupational hazards. Therefore, our study mainly analyzes the ergonomic occupational hazards that may occur during tea-processing work by using a large scale of investigation and interview with tea-processing employees in order to reduce the risks to tea-processing employees.

Methods

1. Subjects

The subjects of this study were mainly employees related to tea processing, including the

two major categories of tea-plucking workers and tea-processing workers. Research subjects were recruited with purposive sampling. According to the distribution of tea farms and the percentage of tea farms and tea processing workers in each county, we carried out a questionnaire investigation and sampling interview. The samples came from tea farms in Hualian County, Nantou County, Chiayi County, New Taipei City, and Miaoli County. Our study collected a total of 362 questionnaires on site, and 346 of them were valid.

2. Questionnaire Design

The questionnaire used in our study consisted of three parts. The first part was personal information such as gender, marital status, occupation, age, height, weight, working hours, and so on. The second part was job description, including the recognition of hazards, safety protection, and risks of postures or movement during work. The third part addressed musculoskeletal discomfort and was revised based on the Nordic Musculoskeletal Questionnaire translated and published by the Institute of Labor, Occupational Safety, and Health [10]. This questionnaire used the “human body figure” with all parts of the body labeled (including neck, shoulders, upper back, lower back/waist, elbows, hands/wrists, hip/legs, knees, and ankles/feet) to ask interviewees about the parts that have discomfort and asked them to evaluate the frequency, time, effects, and level of discomfort.

3. Questionnaire Investigation

We used on-site interviews for the questionnaire investigation. Interviewers gave the questions and options on site and recorded the results. All

interviewers were trained before the interviews in order to ensure that their interview and recording methods were consistent.

4. Analysis

Data collected from the questionnaire were analyzed based on the intentions of this study with SPSS (Ver. 20) to carry out the general description statistics in order to investigate the hazardous factors on all body parts of tea-processing workers.

Results and Discussion

1. Age and Gender Ratio in Employees

In this study, we interviewed 346 tea-processing employees, of which 114 employees (32.90%) were male and 242 employees (67.10%) were female. As shown in the Table 1, the percentage of female workers was twice that of male workers. Dividing job into tea-plucking workers and tea-processing workers, we interviewed 235 tea-plucking workers (67.92%) and 111 tea-processing workers (32.08%). Tea-plucking workers accounted for a significantly larger percentage of the total interviewees, with nearly twice as many tea pluckers and tea processors. The major reason was that tea plucking and tea processing can be viewed as a continuous process. During our research, we found that more laborers were required for tea plucking, more than 20 workers at a time regardless of the area of the tea farms. However, the number of tea-processing workers was limited by the scale of the tea-processing factories. In general, tea-processing factories with a small scale, like a family-based factory, usually have 3-5 laborers.

For those with a larger scale, factories usually have 10 laborers per shift, so tea-processing workers accounted for less percentage of total employees. Regarding the gender ratio of tea-plucking workers, there were 38 males and 197 females. Therefore, the majority of tea-plucking workers were female. This fits the general impression. The gender ratio in tea-processing workers was opposite, 76 males and 35 females. Most of the females were responsible for the sunned wilting and indoor wilting procedures since these two require relatively less physical loading. Other procedures that require more physical loading were done by the male tea-processing workers. We inferred that tea-processing workers need more physical strength to do such works as moving tea leaves, loading tea leaves, rolling tea leaves, and so on. The physical load of these works is much more than tea plucking, so it is more appropriate to have men be responsible for the tea-processing job.

According to the composite of this sample, 25 employees (7.31%) were under the age of 30; 34 employees (9.94%) were aged between 31 and 40; 70 employees (20.47%) were aged between 41 and 50; 103 employees (30.1%) were aged between 51 and 60; and 110 employees (32.16%) were older than 60. The missing value was 4 (1.16%). Using the age of 50 as the critical line, 62.3% of tea-processing workers were older than the age of 50. We found that the age of tea-processing workers was higher, thus showing the current difficulties of the tea industry and agriculture. Younger people would rather work in factories or offices. Therefore, a smaller percentage of young people have entered the agriculture field. A gap was revealed when

passing down the technology. Categorized by job, the age distribution of tea-processing workers was more even, with most employees aged between 41 and 60. Most tea-plucking workers were older than the age of 50, accounting for 67.09%. Most of the tea-plucking workers were from tea-plucking teams in villages. A leader, who might be the worker from a tea farm or tea factory, would contact and organize the entire team. Other members were composed of housewives or seniors who did not have regular work in daily life. Most of them were old enough to be grandparents. Of the tea-processing workers, 14 employees were under the age of 30; 12 employees were aged between 31 and 40; 54 employees (50.0%) were aged between 41 and 60; and 18 employees were older than age of 60. Comparing to tea-plucking workers, the percentage of the elderly was lower in tea-processing workers, which might be due to the larger physical labor required during the tea processing. Furthermore, these workers usually worked at night. Since their continuous working hours were longer, seniors are not suitable for this job.

Table 1 Characteristics of Basic Information

Variables	Total (346)		Tea-Plucking		Tea-Processing	
	N	(%)	N	(%)	N	(%)
Schedule						
Regular	272	78.61%	213	61.56%	59	17.05%
Shift	20	5.78%	5	1.45%	15	4.34%
Irregular	54	15.61%	17	4.91%	37	10.69%
Gender						
Male	114	32.90%	38	16.17%	76	68.47%
Female	232	67.05%	197	83.83%	35	31.53%
Age						
≤30	25	7.31%	11	4.70%	14	12.96%
31~40	34	9.94%	22	9.40%	12	11.11%
41~50	70	20.47%	44	18.80%	26	24.07%
51~60	103	30.12%	65	27.78%	38	35.19%
≥60	110	32.16%	92	39.32%	18	16.67%
Missing 4	4	1.20%				

2. Investigation of Work Environment Hazards and Status

Table 2 shows the potential hazards of tea-processing employees. From the data of this sample of the 346 interviewed employees, 31.8%, 30.1%, and 27.5% experienced very severe muscle soreness, heat stress, and fatigue, respectively, accounting for one-third of interviewees. Meanwhile, 20.24%, 29.4%, and 26.0% of employees suffered severe muscle soreness, heat stress, and fatigue, respectively. Combining the very severe group with the severe group, the top three risks were fatigue (53.5%), muscle soreness (52.04%), and heat stress (49%). This shows that half of the people suffered the above hazards with at least a severe level. These results are significant, and proposing related solutions should be our first priority in the future.

Dividing our data into tea-plucking workers and tea-processing workers based on job type, we found that hazard recognition varied with the different job types. With regard to heat stress in tea-processing employees, 92 (39.15%) tea-plucking workers had very severe heat stress, and 43 (18.3%) workers had severe syndromes. Therefore, heat stress in tea-plucking workers is the problem that should be addressed first. For tea-processing workers, 12 (10.81%) workers had very severe syndromes, and 24 (21.62%) had severe syndromes. Therefore, one-third of employees also thought that heat stress was a serious issue in the workplace. From the above data, heat-related problems are unclear for both tea-plucking workers and tea-processing workers and should be

improved in the future.

As for muscle soreness, 90 tea-plucking workers (38.30%) had very severe muscle soreness and 42 workers (17.87%) had severe muscle soreness. These results were almost the same as those of the heat stress investigation. Therefore, the muscle soreness risk also has to be resolved. Among tea-processing workers, 20 (18.02%) had very severe muscle soreness, and 28 (25.23%) had severe muscle soreness. These results were significantly higher than those of heat stress. Therefore, tea-processing workers consider sore muscles a very serious hazard in the workplace. From the above data, muscle soreness is a common problem in both tea-plucking workers and tea-processing workers, so we should aim to improve this issue in the future.

Muscle soreness and fatigue are often caused by repetitive tasks. We will now discuss tea-plucking workers and tea-processing workers from two separate aspects. Tea-plucking workers usually start tea plucking at 6 am and perform their task three to four times in the morning and twice in the afternoon. Therefore, workers pluck five to six times a day. When plucking tea leaves, workers have to stand up for a long time and bend over or lower their heads. They carry baskets that can weigh as much as 10 kg when full for a long time on their backs. This may be the main cause of their sore muscles and fatigue. For tea-processing workers, sore muscle and fatigue may be caused by inappropriate methods of applying force or adopting wrong postures. The rolling procedure requires considerable effort since workers need to rub the cloth tight with strength. If workers

improperly apply force, they can develop sore muscle or get hurt.

Furthermore, the results showed that 21.7% employees, one-fifth of all interviewees, thought that slip and fall hazards were serious or even very serious. The opinions of both tea-plucking workers and tea-processing workers were the same. Therefore, we should also pay attention to the risk of slips and falls. For tea-plucking workers, tea farms are mainly located on steep slopes, so workers easily slip due to environmental factors when walking uphill or downhill. Meanwhile, for tea-processing workers, tea dust is often on the floor and makes the floor slippery. Furthermore, tea-processing workers walk around frequently during their work, thus increasing the risk of falls. These issues should be addressed through labor education in order to prevent slipping accidents in the future.

Regarding mechanical injury, 27.24% tea-plucking workers thought that the risk of cutting injury was severe, which is worthy of further attention. As we observed, cutting injuries mainly occurred when tea-plucking workers used sharp knives during the plucking. This kind of cutting injury is usually not very serious, but we still need to prevent it.

As for the noise, we found that 20.73% of tea-processing workers thought that workplace noise hazards were serious and worth special note. According to our observation, the noise was caused by operating machines in the tea-processing factories. The risk becomes much more serious when more machines are operating at a single time and smaller workplace or in a closed space during

the panning procedure.

Table 2 Hazards in Workplace (N=346)

Hazard	Job Type	Very Severe	Severe	Fine (N / %)	Minor	No Effect
Slip		36 (10.40%)	39 (11.3%)	89 (25.7%)	44 (12.7%)	138 (39.9%)
	Pluck	23(9.79%)	28(11.9%)	59(25.11%)	28(11.91%)	97(41.28%)
	Process	13(11.71%)	11(9.91%)	30(27.03%)	16(14.14%)	41(36.94%)
Airborne Grease & Smoke		12 (3.5%)	13 (3.8%)	24 (6.9%)	19 (5.5%)	278 (80.3%)
	Pluck	6(2.55%)	2(0.85%)	9(3.83%)	5(2.13%)	213(90.64%)
	Process	6(5.41%)	11(9.91%)	15(13.51%)	14(12.61%)	65(58.56%)
Noise		12 (3.5%)	22 (6.4%)	51 (14.7%)	15 (4.3%)	246 (71.1%)
	Pluck	6(2.55%)	5(2.13%)	12(5.11%)	6(2.55%)	206(87.66%)
	Process	6(5.41%)	17(15.32%)	39(35.14%)	9(8.11%)	40(36.04%)
Heat		104 (30.1%)	67 (19.4%)	104 (30.1%)	10 (2.9%)	61 (17.6%)
	Pluck	92(39.15%)	43(18.30%)	62(26.38%)	7(2.98%)	31(13.19%)
	Process	12(10.81%)	24(21.62%)	42(37.84%)	3(2.70%)	30(27.03%)
Burn		28 (8.1%)	20 (5.8%)	56 (16.2%)	18 (5.2%)	224 (64.7%)
	Pluck	20(8.51%)	10(4.26%)	26(11.06%)	8(3.40%)	171(72.77%)
	Process	8(7.21%)	10(9.01%)	30(27.03%)	10(9.01%)	53(47.75%)
Cutting Wound		36 (10.42%)	39 (11.3%)	125 (36.1%)	42 (12.1%)	104 (30.1%)
	Pluck	30(12.77%)	34(14.47%)	91(38.72%)	31(13.19%)	49(20.85%)
	Process	6(5.41%)	5(4.50%)	34(30.63%)	11(9.91%)	55(49.55%)
Sore Muscle		110 (31.8%)	70 (20.24%)	98 (28.3%)	20 (5.8%)	48 (13.9%)
	Pluck	90(38.30%)	42(17.87%)	68(28.94%)	12(5.11%)	23(9.79%)
	Process	20(18.02%)	28(25.23%)	30(27.03%)	8(7.21%)	25(22.52%)
Fatigue		95 (27.5%)	90 (26.0%)	105 (30.3%)	16 (4.6%)	40 (11.6%)
	Pluck	15(13.51%)	27(24.32%)	43(38.74%)	10(4.26%)	20(8.51%)
	Process	80(34.04%)	63(26.81%)	62(26.38%)	6(5.41%)	20(18.02%)
Small Space		7 (2.0%)	15 (4.3%)	73 (21.1%)	13 (3.8%)	238 (68.8%)
	Pluck	6(2.55%)	8(3.40%)	25(10.64%)	7(2.98%)	189(80.43%)
	Process	1(0.90%)	7(6.31%)	48(43.24%)	6(5.41%)	49(44.14%)

3. Investigation of Implementation of Safety Intervention of Occupational Accidents

According to our data, among the 346 tea-processing employees, 175 employees (50.6%) thought that safety intervention was properly implemented while 22 employees (3.36%) thought that such intervention was poorly implemented (please see Table 3). Although the results showed that most tea-processing employees thought safety intervention was well implemented, we found that safety intervention was not actually implemented in most workplaces.

For example, the tea farms in our study that had steep slopes did not provide such protection as railings, handrails, or anti-slip steps to prevent slips and falls. Furthermore, the safety of vehicles

was poor. No personal protective equipment, such as respiratory protection, was used for spraying pesticides. Using the tea-processing factories as an example, we did not see any protections, such as good ventilation, prevention of inhaling tea dust, prevention of entanglement when operating machines, or any safety protection, during our visit. With regard to transportation, no attention was paid to traffic safety. A small truck with 20-30 people was often seen on the farm. The truck was overcrowded and not equipped with seat belts. It would be very dangerous if an accident occurred. From our research, we could see that the recognition of workplace safety was not sufficient, and more education and intervention are needed in the future.

Table 3 Implementation of Occupational Safety Prevention

Implementation Level	Total (N=346)		Pluck		Process	
	N	%	N	%	N	%
Very Good	42	12.14	25	7.23	17	4.91
Good	133	38.44	78	22.54	55	15.9
Average	143	41.33	114	32.95	29	8.38
Poor	10	2.89	8	2.31	2	0.58
Very Poor	1	0.29	1	0.29	0	0
Not Necessary	11	3.18	4	1.16	7	2.02
Have No Idea	6	1.73	5	1.45	1	0.29

4. Investigation of Discomfort of Working Postures and Movements

We investigated ten working postures and movements. We found that the most uncomfortable one was standing for too long, which was reported by 172 employees, accounting for 49.7%. The second most uncomfortable movement was repeated tasks with hands, reported

by 122 employees, accounting for 35.4%. Then, 114 employees had poor posture, accounting for 33.0%. The three aforementioned items of discomfort were reported by more than one-third of all employees. Other discomforts, such as when moving heavy loads, was reported by 81 employees, accounting for 23.4%. We should propose improvement methods for these four items to relieve the discomfort of employees. Please see Table 4 for more details.

Table 4 Discomfort of Working Postures or Movements

Body Part	Discomfort	
	N %	百分比
Whole Body Vibration	24	6.9%
Use Tools Causing Hands Vibration	23	6.6%
Hands with Repeated Movements	122	35.4%
Use Heavy Tools in Hands	27	7.8%
Moving & Shipping Heavy Loads	81	23.4%
Unnatural Posture	114	33.0%
Standing Up or Walking for a Long Time	172	49.7%
Contact with Skin	50	15.0%
Working Speed	10	2.9%
Unfit Chair or Working Platform Height	48	13.9%

5. Investigation of Musculoskeletal Disorders

Our study investigated nine body parts, and the collected data is shown in Table 5. The highest percentage of employees, 80.64%, reported discomfort of their ankles/feet, followed by their hips/legs (78.90%), upper back (73.41%), elbows (71.64%), knees (63.85%), neck (60.9%), hands/wrists (60.08%), shoulders (53.47%), and lower back/waist (45.09%). The uncomfortable parts of the tea-plucking workers differed from those of the tea-processing workers. For tea-plucking workers,

feet/ankles accounted for the highest percentage, while hips/legs, upper back, and hands/wrists were also commonly reported. For tea-processing workers, the order was hips/legs, followed by hands/wrists, and then knees. From the above data, we inferred that tea-plucking workers standing or bending over for a long period of time might be the reason for soreness in the lower limbs. Furthermore, the sore upper back in tea-plucking workers may be the result of carrying baskets for a long time. On the other hand, moving heavy packages may cause soreness of hands/wrists and knees in tea-processing workers.

Table 5 Musculoskeletal Disorders

Body Part	Total		Pluck		Process	
	Discomfort or Not	%	No.	%	No.	%
Neck						
Yes	210	60.69%	142	41.04%	68	19.65%
No	136	39.31%	93	26.88%	43	12.43%
Shoulders						
Yes	185	53.47%	124	35.84%	61	17.63%
No	161	46.53%	111	32.08%	50	14.45%
Upper Back						
Yes	254	73.41%	169	48.84%	85	24.57%
No	92	26.59%	66	19.08%	26	7.51%
Elbows						
Yes	248	71.68%	166	47.98%	82	23.70%
No	98	28.32%	69	19.94%	29	8.38%
Lower Back/Waist						
Yes	156	45.09%	93	26.88%	63	18.21%
No	190	54.91%	142	41.04%	48	13.87%
Hands/Wrists						
Yes	239	60.08%	150	43.35%	89	25.72%
No	107	30.92%	85	24.57%	22	6.36%
Hips/Legs						
Yes	273	78.90%	175	50.58%	98	28.32%
No	73	21.10%	60	17.34%	13	3.76%
Knees						
Yes	221	63.87%	133	38.44%	88	25.43%
No	125	36.13%	102	29.48%	23	6.65%
Ankles/Feet						
Yes	279	80.64%	181	52.31%	98	28.32%
No	67	19.36%	54	15.61%	13	3.76%

6. Problems and Solutions to Labor Shortages in the Tea-Processing Industry

Tea growers in Taiwan are all small farmers. Currently, due to precarious employment, economy insecurity, and hard workloads, most employees in the tea-processing industry belong to a minority, such as elder temporary workers, foreign spouses, or foreign workers. These populations lack a recognition of safety and health in the workplace, as well as professional training, and become occupational safety concerns. Furthermore, younger populations are not willing to work in tea-related industries. Tea processing will face difficulties in the future as experienced workers gradually retire. Therefore, the government should develop policies to assist the cultivation of talents and pass down experience. Our study suggests that the government could establish professional teams specifically for tea-plucking workers and tea-processing workers in order to solve long-term problems regarding the lack of laborers and professionals. For example, the government could offer government subsidies or professional training and establish a virtual information platform for interaction, communication, integration, and matching in order to train people who are willing to work in the tea-processing industry to equip them with various gardening skills (farming, caring, harvesting, and manufacturing). Furthermore, the government could develop professional harvest teams to promote professional contract work, such as a professional team for rice machinery harvest. With these approaches, releasing and enlarging economic incentives can

attract younger people to enter tea-processing related industries.

Conclusions and Suggestions

Our study used questionnaires to investigate the occupational hazards that tea-processing employees may face in the workplace. We received 346 valid questionnaires, and the results could be used to make future improvements. Based on our results and in-depth interviews, our conclusions are as follows:

1. Tea is one of Taiwan's top four exported agricultural products and plays an important role in the country. However, young people do not want to enter this industry, so current tea-processing employees are elderly and less educated. The tea-processing industry will face difficulties caused by a labor shortage and the question of passing down experience once these experienced workers retire. All related units in the government should develop strategies as quickly as possible for the sustainable development of Taiwan's tea industry.
2. We suggest that the government set up professional teams with inter-departmental resources to solve issues related to tea plucking and tea processing. For example, the Council of Agriculture can cooperate with the Ministry of Labor to hold professional technique training courses in order to train people who are willing to work in the tea-processing industry and equip them with various gardening skills (farming, caring, harvesting, and manufacturing). Furthermore,

the government could develop professional harvest teams to promote professional contract work. Finally, an information platform should be set up to help tea farmers cooperate and match up. The Ministry of Labor should also be involved in order to promote and educate employees about recognizing occupational safety and health in order to prevent occupational accidents.

3. The working hours of tea-processing jobs are long. Tea processing requires continuous working, so employees sometimes work more than 10 hours and even at night. Working such long hours can cause both physical and mental illnesses.
4. Of the 346 tea-processing employees interviewed, 31.8%, 30.1%, and 27.5% suffered from very severe muscle soreness, heat stress, and fatigue, respectively, accounting for almost one-third of interviewees. Adding up the people with very severe discomfort and severe discomfort, the top three were fatigue (53.5%), muscle soreness (52.04%), and heat stress (49.5%). The result showed that half of the interviewees thought that the above hazards were serious, and we have to pay attention to these hazards in the future.
5. Our research found that the highest percentage of discomfort was caused by standing for a long time, which was reported by 172 employees, accounting for 49.7%. This was followed by repeated hand movements in 122 cases, accounting for 35.4%, and unnatural posture in 114

cases, accounting for 33.0%. More than one-third of the interviewees stated that they experienced one or a combination of the three aforementioned discomfort items at work, and these results are worthy of noting. Other discomforts, like moving heavy loads, had 81 cases, accounting for 23.4%.

6. Of the 346 interviewees, 84.64% of employees experienced discomfort in their ankles/feet, accounting for the highest percentage. This was followed by hips/legs (78.90%), upper back (73.41%), elbows (71.64%), knees (63.85%), neck (60.9%), hands/wrists (60.08%), shoulders (53.47%), and lower back/waist (45.09%).
7. Our study showed that muscle soreness, heat stress, fatigue, falls, and cutting wounds were more severe hazards among tea-processing employees. We suggest developing plans and solutions to these hazards in order to improve the workplace of tea-processing employees.
8. Results from our investigation show that employees are eager to take courses and receive training in order to prevent occupational accidents. We suggest that the government should increase its budget for labor safety education and encourage all industries to apply for intervention seminars in which industries invite specialists to have a discussion with employees in order to propose feasible strategies.

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