

The Stress-reducing Effects of Gardening Activities and Images of Farming - A Case Study on a Farming Experience Tour in Chiba Prefecture -

Koji MARUTANI¹, Takuji YAMAGUCHI², Ailing HU², Yoshibumi CHIBA², Akio MIZUSHIMA²,
Koichi IKEGAMI¹ and Tadasu TSURUTA¹

¹Graduate School of Agriculture, Kindai University

²Graduate School of Medicine, Juntendo University

e-mail : 1644680005a@nara.kindai.ac.jp

Summary

Recently, gardening activities have been drawing increasing attention for their potential in managing stress and preventing stress-related diseases, particularly for people working in urban areas. However, few studies have been made on whether gardening is effective even for those who are unfamiliar with farm works. Focusing on a farming experience tour carried out in a suburb of Tokyo, this paper aims to examine how the participants' preconceived images of farming may influence the stress-reducing effects of gardening activities. The examination of three salivary substances (α -amylase, cortisol, and oxytocin) of seven examinees reveals that gardening activities have a positive effect in reducing stress, even for those who have negative images of farming (such as it being dirty or laborious). One notable finding is that the oxytocin level increased after performing a gardening activity for some examinees who are considered to have a sociable disposition, possibly as a result of communication with others in the cooperative farm work. These findings may be associated with some distinctive characteristics of gardening as a collaborative work both in the spheres of production and consumption of crops.

Key words : cortisol, oxytocin, stress reduction, urban workers, α -amylase

Introduction

It is commonly accepted that physical exercise has a positive influence on both one's physical and mental health. For example, a report submitted to the US Department of Health and Human Services argues that physical activity can contribute to not only improving metabolism and decreasing the risks of heart diseases but also improving mental well-being by preventing depression and uneasiness which are closely related to one's mental stress (Physical Activity Guidelines Advisory Committee, 2008). At the same time, farming or gardening activities have drawn increasing attention as they have various welfare functions, including improving physical and mental health (Matsuo, 2000; Ikegami 2013). Focusing on these functions, a variety of horticultural therapy practices have been adopted (Japan Horticultural

Well-being Association, 2002).¹As these practices become popular, some scholars have attempted to measure the effectiveness of horticultural therapy in improving mental health (Stowell et al., 2018; Ng et al., 2018).

Recently, as the mental stress of urban workers has become an issue of public concern, attention has been paid to the stress-reducing effects of horticultural therapy.² However, as a program of horticultural therapy (except craft activities such as wreath making) is generally designed in accordance with the growing stage of plants at the designated fields, it is difficult for the majority of busy company employees to regularly attend a full-fledged horticultural therapy program. Therefore, attention has been paid to the stress-reducing effects of one-off gardening activities, as one type of "plant-assisted therapy", which focuses on a brief contact with plants rather than on continuous gardening activities to grow plants (Matsuo, 2002). In line with this trend, van den Berg and Custer (2011) demonstrated that outdoor gardening was more effective than

Received; 31 October 2019. Accepted; 19 December 2020.

人植関係学誌. (J.Japan.Soc.PPR.) 20(2) : 49-57. 2021.
Article (Case research).

indoor reading in alleviating stress among allotment gardeners, by measuring their salivary cortisol and self-reported moods.

In Japan, there has been a growing interest in the health-promotion effect of gardening or farming since around 2010, and the Ministry of Agriculture, Forestry and Fisheries has started to explore effective methodologies in understanding the relationship between gardening and health (NTT Data Institute of Management Consulting, 2013). As gardening necessarily entails outdoor physical activity, it is likely to contribute to improving the mental health of the participants. Among various mental health-related issues, the present study focuses on the stress-reducing effect of gardening, which has attracted increasing attention recently. As early as 2002, the potential of gardening activities for stress reduction was pointed out by Itai (2002), who nevertheless had not provided any quantitative data. Since then, few studies have been made on the stress-reducing or healing effects of gardening activities in both qualitative and quantitative terms (NTT Data Institute of Management Consulting, 2013). The first aim of this paper is, therefore, to explore the characteristic features of the stress-reducing effect of gardening for urban workers, based on the medical data of several biomarkers.

Another focal point of this study is the relationship between the stress-reducing effect of gardening and

the participants' pre-conceived image of farming. As most urban workers today are unlikely to be familiar with farming activities, they may feel stress by taking part in unfamiliar gardening activities, far from alleviating stress. Along with such attributes as sex and age, subjective images of farming may have an influence on the stress-reducing effect of gardening. Our hypothesis is that gardening activities may not be effective in reducing stress for those who have negative images of farming, while they may be effective for those with positive images. As little is known about how the participants' preconceived images of farming affect the stress reduction through gardening activities, the second aim of this paper is to examine this hypothesis, by focusing on a one-off gardening experience tour for urban workers.

This study is based on a joint research project between Juntendo University (the Laboratory of Palliative Medicine, Faculty of Medicine) and Kindai University (Laboratory of Environmental Policy, Faculty of Agriculture), in which the first author took charge of the survey on the examinees' images of farming and their relationship to medical data.

Methodology and Data Collection

1. Outline of Field Survey

This study focuses on seven urban workers who joined a two-day one-night farming experience tour

Table 1. Timetable for the farming experience tour in chiba.

		1st Day (6th March 2017)		2nd Day (7th March 2017)	
Weather ^z		Rainy (at 14:00)		Cloudy (at 11:00)	
Temperature ^y		10.6 °C (at 14:00)		7.7 °C (at 11:00)	
Time schedule	10:00	Gathering at Tokyo Station		8:00–8:30	Salivary test + HRV test
		Salivary test		8:30–9:30	Breakfast
		POMS2® questionnaire		9:30–10:00	Salivary test, HRV test, and sociological questionnaire
	12:00–13:00	Arriving at "The Farm" and Lunch		10:00–11:30 Gardening activity	
	13:00–13:30	Salivary test + HRV test ^x		11:30–12:00	Salivary test +HRV test
	13:30–14:30 Bushcraft			12:00–12:45	Lunch and checkout
	14:30–15:00	Salivary test, HRV test and check-in		12:45–13:15	Salivary test, HRV test, and leaving "The Farm"
	15:30–18:00	Free time			POMS2® questionnaire
	18:00–18:30	Salivary test + HRV test		15:30–16:00	Salivary test and breakup
	18:30–19:30	Dinner			
	19:30–21:00	Free time (taking a hot spring)			
	21:00–21:30	Salivary test + HRV test			

^zWeather and temperature provided here are those of the point of time when the main activity of each day (bushcraft and gardening) took place.

^yTemperature was cited from the Japan Weather Association website (<https://tenki.jp/past/2017/12/amedas/3/15/>).

^xHRV (Heart Rate Variability) test was carried out to measure activity and balance of sympathetic and parasympathetic nervous systems. The data from this test are not analyzed in this paper due to the limited space.

which was held from 6th to 7th March 2017 at a farm park (“The Farm”) located in Katori City, Chiba Prefecture. Activities carried out include gardening on the second day and “bushcraft” on the first day (Table 1). The gardening activity consisted of planting potatoes and harvesting carrots, spinach, and cavolo nero (or Italian kale). On the other hand, “bushcraft” in this case was primitive fire making, in which the participants rubbed metals to ignite a fire. It is important to note that, in stark contrast to the cooperative work of the gardening, the work of igniting a fire was a simple task undertaken by the participant alone, with other people merely observing from surrounding areas. All of the participants were company employees,³ made up of four males and three females, in their 20s (three persons), 30s (two persons), and 40s (two persons).

2. Methodology

This study combines two different but interrelated approaches. First, changes in several salivary substances are analyzed from a medical point of view, in order to determine whether the gardening and other activities have a stress-reducing effect or not.⁴ Several saliva components (including α -amylase, cortisol, and oxytocin) of the participants were measured by saliva testing both before and after each activity, in order to examine its stress-reducing effects (Table 1).⁵ α -amylase and cortisol are popular indicators used to determine stress-reducing effects. α -amylase tends to increase through exposure to unpleasant stimulation, and decrease through exposure to pleasant stimulation. Cortisol levels are considered to increase under the presence of physical or mental stresses (Izawa et al., 2007). Meanwhile, the increase of oxytocin, dubbed “the hormone of affection”, is likely to be associated with communication with others (Maruyama, 2015; Moberg, 2013; Takahashi, 2014).

Secondly, this study examines the relationship between the reduction of stress and the participants’ attributes, including their preconceived images of farming. A sociological questionnaire was carried out immediately before the gardening activity in order to reveal the examinees’ attributes including their native places, their expectations for the entire tour and individual activities, and whether they experience stress in their daily lives. For these questions, the examinees were asked to mark the points based on a ten-point grading scale. At the

same time, we provided twelve images of farming with the examinees (Table 2), who in turn gave a score for each image on the 100-point grading system.⁶ For example, if one strongly agrees with a certain key word or phrase (e.g., “(gardening is a) dirty (work)”), he or she marks 100 points; conversely, if one strongly disagrees, he or she may mark zero points. They were asked to mark the midpoint (50) if they neither agree nor disagree with the given image. A similar instruction was given for the other questions which applied to the ten-point grading system.

In addition, a medical questionnaire (POMS2®) was carried out both before and after the entire tour in order to understand changes in the participants’ personal moods. In this paper, only TMD (Total Mood Disturbance) score, that is an indicator of negative emotions, will be utilized due to the limited space.⁷ If TMD score decreases after the tour, it means that the examinee reduced the negative emotions which might be associated closely with one’s stress.

3. Ethical Considerations

This research was approved by the committee for biological ethics at the Faculty of Agriculture, Kindai University (No. 2016-15) and by the committee for research ethics of the Faculty of Medicine, Juntendo University (No. 2016128). The examinees were informed in advance of the purpose of this study, methodology, and how to handle personal information. They were also notified that they were allowed to withdraw from the test at any time, and that this study was approved by the ethical committees of both Kindai and Juntendo Universities.

Research Results

1. Outline of Stress-reducing Effects

First, we are going to examine changes in the concentration of saliva components (α -amylase, cortisol, and oxytocin), before and after both the bushcraft and gardening activity (see Table 3 for the average figures and Table 4 for the individual data of the seven examinees). After the gardening activity, the average concentration of α -amylase reduced by about 15%, from 8.71 to 7.42 kIU/l and that of cortisol declined by about 67%, from 0.31 to 0.10 μ g/dl. After experiencing bushcraft, the average concentration of α -amylase reduced by about 43%,

Table 2. Images of farming listed in the questionnaire survey.

Image	Items
Negative	Dirty
	Laborious
Positive	Getting close to nature
	Reducing stress
	Fragrance of crops is attractive
	Anticipating tasting harvested crops
	Rural landscape is attractive
Neither positive nor negative	Observing plants' color and growth has a therapeutic effect on me
	It is difficult to experience if one lives in an urban area
	Farming is familiar to me as I practice it once in a while
	A leisure requiring physical activities
	Strong association with rurality

Table 3. Concentration of salivary substances before and after activities (average value for seven examinees) .

Measured salivary substance	Gardening activity			Bushcraft			
	Before	After	Rate of change	Before	After	Rate of change	
α -amylase	Concentration (kIU/l)	8.71	7.42	-15%	16.14	9.14	-43%
	Standard deviation	4.15	4.11		13.20	4.45	
Cortisol	Concentration (μ g/dl)	0.31	0.10	-67%	0.32	0.10	-68%
	Standard deviation	0.19	0.05		0.22	0.03	
Oxytocin	Concentration (pg/ml)	25.8	34.8	35%	66.2	60.3	-9%
	Standard deviation	16.9	19.8		42.4	46.8	

Table 4. Examinee's attributes, images of farming, and stress reduction.

Examinee No.	Sex	Age	Images of farming (100 point grade scale)		Changes in concentration of salivary substances before and after activities						Change of TMD score	Scores from questionnaire survey (10 point grade scale)				
					α -amylase (kIU/l)		Cortisol (μ g/dl)		Oxytocin (pg/ml)			Native place	Everyday stress and uneasiness	Expectations for the whole tour	Expectations for the gardening activity	Expectations for the dinner party
			Gardening Activity	Bushcraft	Gardening Activity	Bushcraft	Gardening Activity	Bushcraft								
6	M	30s	95.0	36.7	0.00	0.00	-0.42	-0.58	30.1	-3.76	-86	3	3	10	9	10
1	M	40s	75.0	70.0	-8.00	-7.00	-0.41	-0.47	-0.45	-23.6	-82	5	9	6	8	5
4	F	30s	60.0	58.3	-4.00	-28.0	-0.09	-0.07	1.92	-14.4	-44	6	7	5	10	7
5	F	20s	55.0	73.3	-4.00	2.00	-0.06	-0.06	17.6	46.9	-40	10	2	7	10	7
7	M	20s	45.0	48.3	1.00	4.00	-0.04	-0.24	17.1	9.77	-66	7	2	8	10	8
3	F	40s	35.0	60.8	1.00	-24.0	-0.11	-0.09	-1.86	-14.2	-26	9	8	7	8	7
2	M	20s	15.0	75.0	5.00	4.00	-0.34	0.00	-0.89	-41.9	6	10	8	7	10	6
Average			54.3	60.4	-1.29	-7.00	-0.21	-0.22	9.06	-5.88	-48.3	7.14	5.57	7.14	9.29	7.14
Standard deviation			24.3	13.0	3.99	12.5	0.16	0.21	11.6	26.2	30.2	2.47	2.87	1.46	0.88	1.46
Significant difference					n.s.	n.s.	p<0.05	p<0.05	n.s.	n.s.						

We carried out paired t-test on changes in salivary substances for each activity. As the above figures show, we found significant differences in cortisol both for gardening and bushcraft, whereas we could not find significant difference in the cases of α -amylase and oxytocin.

from 16.14 to 9.14 kIU/l and that of cortisol reduced by about 68%, from 0.32 to 0.10 μ g/dl. As indicated in the values of standard deviation, the pattern of change varies widely between the individual examinees. For example, while α -amylase declined for three examinees, its level slightly increased or

retained stable for the other four examinees, both in the cases of gardening and bushcraft (Table 4). On the other hand, cortisol decreased for almost all the examinees. Overall, however, the participants' saliva components as stress indicators were reduced by both the gardening activity and bushcraft.

On the other hand, the average concentration of oxytocin increased by about 35%, from 25.77 to 34.83 pg/ml after the gardening activity. Meanwhile, after experiencing bushcraft, the average concentration of oxytocin decreased by about 9%, from 66.21 to 60.33 pg/ml. A considerable difference among examinees, as indicated in the values of standard deviation in Table 3 and each individual data in Table 4, will be closely examined further below.

2. Some Personal Features of the Examinees

In the questionnaire, along with the examinees' basic attributes (age, sex, and native prefecture), we posed a question regarding their native places, asking whether they hailed from urban areas or the countryside. A ten-grade evaluation was applied to assess whether they were from urban or rural areas (one point for rural extreme, and 10 points for urban extreme). The average point was 7.1 (standard deviation 2.67), ranging from 3 to 10, showing that most examinees hailed from urban or peri-urban areas (Table 4).

The examinees were also asked whether they feel stress or uneasiness in their daily lives, at their workplaces or localities where they live. They were asked to rate these on a scale of 1 to 10; 10 being most stressful, and 1 being an utter lack of such feelings. The average point was 5.57 (standard deviation 2.87), with a definite gap between the low stress group (Nos. 5, 6, 7) and the high stress group (Nos. 1, 2, 3, 4), as shown in Table 4.

The examinees were asked to rate their expectations on the stress-reducing effect of the entire tour, as well as their expectations on individual events including the gardening activity and the dinner party. They evaluated their expectations on a scale from 1 to 10; one point signifying the lowest expectation, and 10 points signifying the greatest expectation. As to the expectation for the whole tour, the average score was 7.14 (standard deviation 1.46), showing a relatively high expectation among the examinees (Table 4).

Based on the assumption that the stress-reducing effect of gardening activities is high among those who have positive images of farming, and low among those who have negative images of farming, we examined the relationship between each examinee's changes in saliva component concentrations and their preconceived images of farming as well as other attributes. Table 5 shows the average scores for eight different images of farming (two for negative

images and six for positive images).⁸ The highest score was marked for the image "Anticipating tasting harvested crops" (average score 85.7, standard deviation 15.0), followed by "Getting close to nature" (average score 71.4, standard deviation 24.2). Meanwhile, negative images had relatively low average scores (58.6 for "dirty" and 50.0 for "laborious"). At the same time, the average score for the image "Reducing stress" was as low as 38.6, indicating that most examinees thought that the gardening activities were not very effective in reducing stress.

3. Relationship between the Image of Farming and Stress Reduction

Table 5 also shows the correlation between concentration changes in three saliva components after gardening and the average scores of preconceived images of farming. The correlation coefficient of each pair of an image and a saliva component is generally low, and there is no combination that indicates a strong correlation. Although there are five combinations with correlation coefficients being less than -0.60 (shaded cells in the table), the correlation is generally low in other saliva components for each of the same image of farming. For example, a concentration change of oxytocin and the image "landscape is attractive" exhibits a relatively high negative correlation, but there is little correlation for the same image with respect to α -amylase and cortisol.

Next, let us examine the seven examinees individually, focusing on the association between changes in concentration of saliva components after gardening and each examinee's attributes in particular images of farming. As can be seen in Table 5, the images of farming were divided into two categories of negative and positive images; two items were classified as negative and six as positive. The average score for each category, designated as "negative point" and "positive point", respectively, was calculated for each examinee. In Table 4, the data for each examinee is arranged according to negative points in descending order from top to bottom. As this table shows, examinees with a high negative point do not necessarily have a low positive point. No. 6 is a typical person who has negative images of farming, with a high negative point and a low positive point. It is also interesting to note, in passing, that No. 6 regards himself as hailing from

Table 5. Correlation coefficient between images of farming and changes in salivary substances.

	Images of farming	Average score	Standard Deviation	Correlation coefficient		
				Cortisol	α -amylase	Oxytocin
Negative image	Dirty	58.6	31.8	-0.68	-0.30 ²	0.55
	Laborious	50.0	25.6	-0.32	-0.36	0.42
Positive image	Getting close to nature	71.4	24.2	-0.01	-0.50	0.00
	Reducing stress	38.6	24.2	0.19	0.29	-0.50
	Fragrance of crops is attractive	51.4	24.7	-0.37	0.41	-0.64
	Anticipating tasting harvested crops	85.7	15.0	-0.62	-0.17	0.24
	Landscape is attractive	52.9	24.3	0.04	0.08	-0.70
	Observing plants' color and growth has a therapeutic effect on me	62.1	16.4	0.03	0.04	-0.69

²t(5)=-3.06, p=0.03, p<0.05.

We carried out t-test on the assumption that there is no correlation between two variables(r=0) . The result was that only the correlation between α -amylase and "dirty" has the validity. However, the correlation between them is actually not so close(r=0.30) .

the countryside, giving the lowest score among seven examinees for the question of native place. On the other hand, Nos. 2 and 3 are considered to have positive images of agriculture, with a low negative point and a high positive point. However, other examinees did not show such a straightforward tendency.

Let us examine our hypothesis that the higher negative point one has, the less effective the gardening activity is in reducing his or her stress. As we have seen, on average, α -amylase and cortisol decreased both after bushcraft and after the gardening activity. A closer look at the data of the individual examinees reveals that there is a tendency contrary to the original hypothesis. As shown in Table 4, except for No. 6, the greater the negative points one has, the greater the decrease in α -amylase concentration after farm work, suggesting a higher stress-reducing effect. A similar trend is also observed, although to a lesser extent, in the case of cortisol.

On the other hand, the other saliva component, oxytocin, indicates a different trend; while oxytocin decreased after bushcraft, it rose significantly after the gardening activity. Notably, No. 6, as a typical person with a negative image of farming, displayed by far the highest increase in oxytocin after the gardening activity. No. 6 also had high expectations for the entire tour and the dinner party (Table 4). It is reasonable to assume that No. 6 has a penchant for enjoying communication with others. On the other hand, No. 1, with the lowest score for the expectations of the dinner party, demonstrated a

decrease in oxytocin after the gardening activity. Three examinees with increased oxytocin (Nos. 6, 5, 7) shared a common feature in that they rarely felt stress in their everyday lives. Conversely, three examinees (Nos. 1, 2, 3) with decreased oxytocin were more likely to experience stress and anxiety (Table 4).

Finally, let us examine TMD scores, a general indicator of negative emotions, based on the data of POMS2® test collected before and after the entire tour. The average value of TMD scores reduced by as much as 89% from 54.1 (standard deviation 45.8) to 5.86 (standard deviation 25.5) before and after the entire tour. It is evident from Table 4 that there is a high correlation between the negative points and the decrease in TMD scores. In other words, people with a negative image of farming had a greater reduction of negative feelings after the tour.

Discussion and Concluding Remarks

The examination of three salivary substances suggests that the gardening activity has some stress-reducing effect for urban workers. We have also demonstrated that there is hardly any correlation between stress-reducing effects of gardening and the examinees' preconceived images of farming. This is discordant with our original hypothesis that gardening activities may not be effective for those who have negative images of farming. On the contrary, in general, α -amylase and cortisol, along with TMD scores, decreased equally or more so among those examinees with negative images of

farming, suggesting similar stress-reducing effects of gardening regardless of preconceived images.

The most notable point of our research findings is that the oxytocin level increased (on average) after gardening activity, while it decreased after the simple and solo work of bushcraft. Studies on oxytocin suggested that it is closely associated with social bonding, in which communication (such as physical contact, eye contact, conversation and cooperation) plays a central role (Nagasawa et al., 2009; Moberg, 2013; Takahashi, 2014; McClung et al., 2018). During the gardening activity, we observed that there was an active interaction among participants, including friendly exchanges of words and taking photographs with each other. Oxytocin may have been secreted due to the fact that communication was promoted through planting and harvesting as a joint work with others. In contrast, bushcraft was a solo operation, lacking the nature of collaborative work. While a strong correlation between oxytocin and each image of farming could not be found, the increase in oxytocin was greater among those who did not feel daily stress and who looked forward to the dinner party. As the expectations for the dinner party may be closely associated with one's propensity for enjoying social gatherings, it is possible that oxytocin may have been released more among those who value communication with others, prompted by cooperation in the gardening activity.

Another possible interpretation for the increase of oxytocin after the farm work is that its secretion may have been enhanced by the joy of harvesting crops, which they were allowed to bring back home. On average, the examinees had high scores for the images of farming in particular "Anticipating tasting harvested food" and "Getting closer to nature", among others. The act of touching and harvesting crops may bring a feeling of achievement and satisfaction, which is likely to be associated with the happiness of eating as well as the secretion of oxytocin.

Thus, one of the unique features of gardening activities in terms of stress reduction may lie in the fact that it enhances the secretion of oxytocin. Takahashi (2014) states that "Oxytocin works as a promoter to build positive and favorable bonds between people", and it plays a very important role in building good relationships. It is also considered to have the effect of suppressing the secretion of cortisol resulting from stress. In addition, oxytocin has been proved to be involved in cardiovascular

enhancement, metabolic function promotion, and analgesic effects (Takahashi, 2014). In other words, the secretion of oxytocin has the potential to achieve not only anti-stress effects but also health benefits.

Another key finding of the present study is that the stress-reducing effect of gardening may not be related only to the act of gardening per se but also to other elements of the whole event, including co-eating (dinner party) and other occasions for communication with others. As the above analysis of individual scores of TMD, oxytocin, and the questionnaire indicates, the analysis of the gardening activity alone may not be enough to understand the stress-reducing effect of the farming experience, which cannot be separated from other factors in the tour as a whole.

This study is a single case study based on data collected from only seven participants during a short time frame. To validate the results mentioned above, future research should involve a larger sample size, as well as various farm works other than planting and harvesting, as different work contents may bring about different stress-reducing effects.

Notes

- 1 For example, Holistic Retreat Center Suirin, based in the Iizuna highlands, Nagano Prefecture, introduces horticultural therapy into its free-school program, with the aim of social reintegration of hikikomori, i.e. reclusive young people withdrawing from society (Suirin, 2020). Keikoen in Buzen City, Fukuoka Prefecture, offers four kinds of therapeutic activities including gardening to people with a serious mental disability (Keikouen, 2020).
- 2 See, for example, Yoshida (2018).
- 3 The examinees were recruited from the same company in Tokyo. Although they responded to the invitation voluntarily, they joined the event as a part of their duties. The small number of examinees is due principally to the difficulty in recruiting a large number of participants at the same time as well as the capacity of the farm facility.
- 4 The outline of the analysis of medical data has already been reported in Yamaguchi et al. (2017), which analyzed the data of ten examinees including three post-graduate students who joined the tour as research staff. We have excluded the data of these three students, as we focus only on

company employees in this paper.

- 5 Saliva Collection Aid Kit (Salimetrics, USA) was used to collect saliva, and the obtained saliva was stored frozen at -20°C until measurements. The saliva was collected before and after each activity and the amount collected per measurement was 1ml. The α -amylase, cortisol, and oxytocin in the frozen saliva were measured by using the specified measurement kit for each; cortisol - Salivary Cortisol Enzyme Immunoassay Kit (Salimetrics, USA), Oxytocin - ELISA Kit (Enzo, USA), and α -amylase - Salivary Amylase Monitor (Nipro, Japan).
- 6 We apply a 100-grading system (rather than a 10-point grading system) here because we intended to make a more detailed analysis about the images of farming than other attributes.
- 7 POMS (Profile of Mood States) is a method of questionnaire focusing on personal mood and emotion at a particular time, developed by McNair and his colleagues in 1964 in the United States (Heuchert and McNair, 2012). TMD score is calculated by subtracting the score for "vigor" from the sum total of scores for sets of negative emotion including tension (or anxiety), anger (or hostility), fatigue (or inertia, depression (or dejection), and confusion (or bewilderment).
- 8 We excluded here four out of twelve images of farming which cannot be categorized either as overtly negative or positive (see Table 2).

Literature Cited

- Heuchert, J. P. and D. M. McNair. 2012. Profile of Mood States -second edition (POMS2). Toronto.
- Ikegami, K. 2013. Agriculture's potential for well-being. Nosangyoson Bunka Kyokai, Tokyo (In Japanese).
- Itai, S. 2002. Mental health and gardening. pp. 133-152. In: E. Matsuo and M. Shoyama(eds.). Exploring strange power of plants. Kyushu University Press, Fukuoka (In Japanese).
- Izawa, S., K. Shiotsuki, N. Sugaya, N. Ogawa, K. Suzuki and S. Nomura. 2007. The application of saliva to an assessment of stress: procedures for collecting and analyzing saliva and characteristics of salivary substances. Japanese Journal of Complementary and Alternative Medicine 4(3): 91-101 (In Japanese).
- Japan Horticultural Well-being Association (ed.). 2002. A Guide to horticultural well-being. Soshin-sha, Tokyo.
- Keikouen. 2020. Keikouen homepage (<http://keikouen.org>, retrieved on 15 January 2020).
- Maruyama, S. 2015. Handbook for stress research. Sogensha, Tokyo (In Japanese).
- Matsuo, E. 2000. Exploring horticultural therapy (enlarged edition). Green Information, Nagoya (In Japanese).
- Matsuo, E. 2002. Horticultural therapy and horticultural well-being. pp. 3-44. In: E. Matsuo and M. Shoyama (eds.). Exploring strange power of plants. Kyushu University Press, Fukuoka (In Japanese).
- McClung, J. S., T. Zegni, C. Fabrice, B. Adrian and B. Redouan. 2018. Endogenous oxytocin predicts helping and conversation as a function of group membership. Proc. R. Soc. B. 285: 20180939.
- Moberg, K. U. 2013. The Hormone of closeness: The role of oxytocin in relationships. Pinter & Martin, London.
- Nagasawa, M., T. Kikusui, T. Onaka and M. Ohta. 2009. Dog's gaze at its owner increases owner's urinary oxytocin during social interaction. Hormones and Behavior 55:434-441.
- Ng, K. S. T., A. Sia, M. K. W. Ng, C. T. Y. Tan, H. Y. Chan, C. H. Tan, I. Rawtaer, L. Feng, R. Mahendran, A. Larbi, E. H. Kua and R. C. M. Ho. 2018. Effects of horticultural therapy on Asian older adults: A randomized controlled trial. Int. J. Environ Res. Public Health 15(8): 1705.
- NTT Data Institute of Management Consulting. 2013. A report of the study on gathering evidences of the relations between gardening and health. A survey commissioned by the Ministry of Agriculture, Forestry and Fisheries, 2012 (In Japanese).
- Physical Activity Guidelines Advisory Committee. 2008. Physical activity guidelines advisory committee report, 2008. Washington, DC: U.S. Department of Health and Human Services.
- Stowell, D. R., G. P. Owens and A. Burnett. 2018. A pilot horticultural therapy program serving veterans with mental health issues: Feasibility and outcomes. Complementary Therapies in Clinical Practice 32: 74-78.
- Suirin. 2020. Suirin homepage (<https://suirin.com>, retrieved on 15 January 2020).
- Takahashi, T. 2014. Human becomes healthy by loving others: Oxytocin, the hormone of affection. Chido-shuppan, Tokyo (in Japanese).

- Van den Berg, A. E. and M. H. G. Custers. 2011. Gardening promotes neuroendocrine and affective restoration from stress. *Journal of Health Psychology* 16 (1): 3-11.
- Yamaguchi, T., Y. Chiba, A. Hu, K. Marutani, T. Ohnaka, S. Iwakawa, N. Hikima, A. Konishi and A. Mizushima. 2017. Stress-reducing effects of gardening and nature experience in an agricultural park. *Stress Science* 33: 169 (In Japanese).
- Yoshida, T. 2018. Prevent Depression! Hormone of Happiness secreted by Farming, Paradigm Shift through Conserving Farmland. *Nikkei Business Online*, 12 January 2018 (<https://business.nikkei.com/atcl/report/15/252376/011100127/>, retrieved on 19 December 2019).

摘 要

園芸活動のストレス軽減効果と農業イメージ
—千葉県農業公園における農作業体験を事例に—

丸谷昂司¹・山口琢児²・胡 愛莉²・千葉吉史²・
水嶋章朗²・池上甲一¹・鶴田 格¹

¹近畿大学大学院農学研究科

²順天堂大学大学院医学研究科

園芸療法にはストレス軽減効果があるといわれている。本研究は園芸のストレス軽減効果と農作業の体験者の農業イメージとの関係に焦点を当てたものである。東京の郊外にある農業公園で農作業などを体験した7名の研究参加者（企業労働者）を対象に、各作業やイベントの前後で唾液成分（ α アミラーゼ、コルチゾール、オキシトシン等）を計測するとともに、農業イメージ等に関する社会学的アンケートを実施した。その結果、農作業前後でほとんどの研究参加者においてストレス軽減効果が見られたのみならず、ネガティブな農業イメージを持つ研究参加者においてさえストレス軽減効果が確認された。特筆すべきは、とりわけ社交的な性格を持つ研究参加者において、おそらく園芸作業を通して他者と積極的なコミュニケーションがとれたことや、収穫の喜びに触れたことが原因で、オキシトシンが増加したことである。このように園芸作業のストレス軽減効果は、農作業の内容だけではなく、それに伴う共同作業によって生じるコミュニケーション機会の創出という側面からも検討する必要があることが示唆された。