

# EFFECT OF FEEDING FERMENTED FRESH CASSAVA PULP ON LACTOPEROXIDASE ACTIVITY AND PERFORMANCE OF HOLSTEIN FRIESIAN CROSSBRED LACTATING DAIRY COWS

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## ABSTRACT

Twenty one Holstein Friesian crossbred lactating dairy cows, averaging 82±17 days in milk, approximately 13.0±1.0 kg of milk and 400±7 kg body weight, were blocked by parity and then stratified random balanced for milk yield, days in milk and body weight into three groups of 7 cows. The first group (control) received approximately 6 kg of 21% crude protein (CP) concentrate. The second group was replacement levels of concentrate by fermented fresh cassava pulp (FCP) at 20% and the third group was replacement levels of concentrate by fermented FCP at 40%. All cows also received *ad libitum* corn silage, and individually fed according to treatments. The experiment lasted for 7 weeks with the first 2 weeks as the adjustment period, followed by 6 weeks of measurement period. Feed offered and left after eating of individual cow were collected on 2 consecutive days weekly and at the end of the experiment feed samples were pooled to make representative samples for proximate and detergent analyses. Daily milk yields were recorded. Milk sample and dry matter intake (DMI) were collected on 2 consecutive days weekly. Live weights were recorded at the start and at the end of the experiment. The results showed no statistical significant differences in intakes, live weight change (LWC) and milk compositions ( $P>0.05$ ). Furthermore, the thiocyanate ion (SCN<sup>-</sup>) concentration and lactoperoxidase (LP) activity did not increased throughout with increasing FCP supplementation by fermented FCP at 20 and 40% respectively. It is recommended in the present study that the replacement levels of concentrate by fermented FCP at 40% could be beneficial to lactating dairy cows in early-mid lactation.

**Keywords:** Fermented fresh cassava pulp, *Aspergillus oryzae*, *Saccharomyces cerevisiae*, milk composition, thiocyanate ion, lactoperoxidase activity

## Introduction

One of the most important problems in animal husbandry is that the animals could not be fed adequately in Thailand. Cassava (*Manihot esculenta*, Crantz), a root crop is the one

of the major crop grown. Fresh cassava pulp (FCP) is by product always sold as a cheap animal feed material in substitution for urea, yeast and others. Therefore, through the solid-state fermentation, protein content in the cassava pulp can be increased that can lower the cost of animal feed. FCP is fermented with fungi (*Aspergillus oryzae*) and yeast (*Saccharomyces cerevisiae*) for protein enrichment before it is used as the high-quality animal feed material (Oboh & Akindahunsi, 2005; Srinorakutara et al., 2006; Ubalua, 2007). Therefore, the objective of this research was to study the effect of feeding fermented FCP on performances of lactating dairy cows. So, in this paper, a prototype is designed, implemented and evaluated by monitoring fermented FCP quality and crude protein (CP) level.

### Literature Review

With the advancement of science and agricultural technology, there are many techniques of process available in the quantified data that improves cassava nutritive values and quality in dairy cattle diets by the utilization agro-industrial by product especially in fresh cassava pulp (FCP). It is an important economic crop in Thailand, which Thailand can produce. Exports of cassava products are among the world's top producing around 21-30 million tonnes. Annual production volume is likely to increase each year. From the starch production process, there is leftover residue or by-product. The back cover is also very good. The remaining pulp contains the nutrient content of 53.55% ash, 2.83% protein, 1.98% crude fiber, 13.59% fat and 0.13% fat (Khempaka, Molee & Guillaume, 2009) Srisaikham et al. (2018) reported that both of FCP and fresh cassava peel, presents large volumes in agro-agricultural by-products from the processing of cassava roots for starch production, has gradually become widely utilised in animal feeds in Thailand, such as in ruminants and poultry feed respectively. Okrathok et al. (2017) demonstrated that cassava pulp fermented with *A. oryzae* can be proved nutritive values in such of crude protein (CP) and used in laying hen (Isa brown) diets up to 24% without negative effects on nutrient digestibility and retention production performance and egg quality Although the cassava is agro industrial by-products and rich of cyanogenic glycoside levels (Wolfson and Sumner, 1993), that are hydrolysed to yield hydrocyanic acid (HCN). HCN is transformed to the non-toxic SCN<sup>-</sup> by the rhodanese action in the liver and kidneys of animals (Drakhshan Vaziri and Aminlari, 2004). The utilization of the HCN content from cassava in ruminant diets has been found to have potential to extend the quality of raw milk during storage at 25°C and 30°C by increasing raw milk SCN<sup>-</sup> levels (Srisaikham et al., 2018). The supplementation of the diets of lactating dairy cows with FCP at 7.0 kg/h/d can be used to extend milk quality, achieved stimulation of LP activity, improved SCN<sup>-</sup> concentration, decrease somatic cell count and prohibit bacterial activity which is the main cause of deterioration of milk over time (Srisaikham et al., 2018).

Fermentation is a biochemical transformation that requires raw materials to be altered. By the activity of enzyme production of microorganisms, element or factor in major fermentation is the type of microorganism. nutrients for microorganisms and fermentation

microorganisms play an important role in the fermentation process, including bacteria, yeast and mold. That is why, instead of using the commercially available fresh cassava pulp (low protein and high fiber contents), researchers design, conduct to investigate the using cassava pulp fermented with *A. oryzae* and *S. cerevisiae* monitoring prototype. From the collection of documents found that many microorganisms can be. fermented feed ingredients and higher protein content such as *Lactobacillus spp.*, *Schawanniomyces sp.*, *S. cerevisiae*, *C. utilis*, *A. fumigatus*, *A. niger*, *A. oryzae* and *Trichoderma pseudokoningii*. (Oboh, 2006; Feng et al., 2007a; Heeok et al., 2010; Thongkratok et al., 2010; David, 2011 cited by Okrathok, 2013). These microorganisms are required nutrients for metabolism, growth and generate an energy. The major food sources are carbon, nitrogen, vitamins and minerals. These nutrients are important for the growth of different microorganisms. However, there are limitations associated with the prototypes like limiting to describe the long-term utilization and dairy cattle' farmers requirements. However, evidence so far shows that cassava meal is good source of energy which, when fortified, promote positive and high performance in ruminants. Cassava meal contains high level of energy and has been used as readily fermentable energy in the rations. Nevertheless, the lack of nitrogen supplied from cassava meal that it is important to include nitrogen sources to balance the energy-nitrogen supply for the ruminal microbial activities. The overall aims of this study are going to develop the alternative products from FCP namely, fermented FCP.

## Objective

To determine the effects of feeding fermented fresh cassava pulp on milk production, milk composition, and live weight change in crossbred Holstein Friesian dairy cows.

## Methods

### 1. Materials and Methods

The experiment was conducted to determine the effects of the fermentation of various levels of fresh cassava pulp with *Aspergillus oryzae* and *Saccharomyces cerevisiae* in diet of crossbred Holstein Friesian dairy cows on productive performance, milk yield, milk composition and milk quality. All experimental procedures were conducted following the Ethical Principles and Guidelines for the Use of Animals issued by National Research Council of Thailand. These components used for designing the experimental research are described below.

#### 1.1 Animals and Treatments

Twenty one Holstein Friesian crossbred lactating dairy cows, averaging  $82 \pm 17$  days in milk,  $13.0 \pm 1.0$  kg of milk,  $55 \pm 16$  months old and  $400 \pm 7.0$  kg body weight, were blocked by parity and then stratified random balanced for milk yield, days in milk and body weight into three groups of 7 cows. Experimental design was Randomized Complete Block Design. Block by milking days first and then stratified random balanced for milk yield and body weight into 3 treatments. The first group (control) received approximately 6 kg of 21% CP concentrate.

The second group was replacement levels of concentrate by fermented FCP at 20% and the third group was replacement levels of concentrate by fermented FCP at 40%. All cows also received *ad libitum* corn silage, had free access to clean water and mineral salt, were individually housed in a free-stall unit and individually fed according to treatments. This study was performed in accordance with the regulations of Suranaree University of Technology Research Committee. The experiment lasted for 7 weeks with the first week (14 days) as the adjustment period, followed by 6 weeks of measurement period.

### 1.2 Fresh Cassava Pulp Collection

The fresh cassava pulp samples were collected once per 3 days from both of Sanguan Wongse Industries Co., LTD., and Korat Flour Industry CO., LTD., Nakhon Ratchasima in the Northeastern region of Thailand. The fresh cassava pulp samples were divided into 2 parts: the first part was fed to experimental cows; the second part was taken and dried at 60 °C for 48 h and ground for proximate analysis and detergent analyses. FCP is fermented with fungi and yeast for protein enrichment before it is used as the high-quality animal feed material. The process to achieve protein-enriched cassava pulp: *A. oryzae* was added and incubated for 3 days, *S. cerevisiae* and urea were then added and incubated for further 7 days. After 10 days incubation, the product was ready to feed to animals.

### 1.3 Feed Intake

Residual feeds were weighed for two consecutive days weekly. Feed samples were taken and dried at 60°C for 48 h. At the end of the experimental period, feed samples were composited and subsamples were taken for further chemical analysis. Samples were also ground through a 1 mm screen and subjected to proximate analysis. CP content was determined by Kjeldahl method (procedure 928.08, AOAC, 1998). Ash content was determined by burning at 550°C for 3 h in a muffle furnace (procedure 942.05; AOAC, 1995). The ether extract was determined by using petroleum ether in a Soxtec System (procedure 948.15, AOAC, 1998). Neutral detergent fiber (NDF), acid detergent fiber (ADF) and acid detergent lignin (ADL) were determined using the modified method for Fiber Analyzer Van Soest et al. (1991). Chemical analysis was expressed on the basis of final DM.

### 1.4 Raw Milk Collection

Cows were milked twice daily per day at 05.00 and 15.00 h and milk yields were recorded for each cow. Samples of milk (evening + morning) were collected at each milking for two consecutive days weekly and stored at 4°C with a preservative (bronopol tablet; D&F Control System, San Ramon, CA) until analyzed for fat, protein, lactose and solid-not-fat contents using a Milko-Scan S50 analyzer (Tecator, Denmark). SCN<sup>-</sup> concentration (Codex Alimentarius Commission (CAC GL 13/91) (CAC, 1991b), LP activity (Isobe et al., 2009). All cows were weighed at the start and end of the experiment to calculate LWC.

## 2. Statistical Analysis

All obtained data of intake, milk production, milk composition, SCN<sup>-</sup>, LP activity and body weight change were analyzed by ANOVA for a randomized complete block design using the Statistical Analysis System (SAS, 1996). Differences between treatment means were statistically compared using Least Significant Differences (Steel and Torrie, 1980).

## Results and Discussion

### Chemical Composition of Experimental Diets

The analyzed values of chemical composition of the feeds are in the range reported in the case of SUT (Srisaikham et al., 2018). Large variations in chemical composition of feeds reflect the differences in breeds, harvesting processes, soil types, fertilizer applications, season and location etc. DMI and LWC are shown in Table 1. As affected by fermented FCP replacement levels, the lower DM intakes ( $P < 0.05$ ) were found in the 40% fermented FCP replacement treatment. DMI significantly reduced when increasing fermented FCP in the diets due to fermented FCP had higher moisture compared with concentrate. Research on DM intake containing fermented FCP to lactating dairy cows is very limited. However, Okratok (2013) demonstrated that all fermented cassava pulp with *A. oryzae* substituted laying hen diets at 0, 16, 24 and 32% thorough 8 weeks had no effects on feed intake. LWC were similar for all treatments which is in agreement with the reports of Sommart and Bunnakit (2004) fed Brahman or Charolais-Brahman crossbred yearling beef cattle with concentrates containing 50% cassava pulp found no significant difference in body weight gain (BWG) between the treatment. Nitipot et al. (2004) replaced cassava chip by cassava pulp at a rate of 0, 50, and 100% in the concentrates and fed crossbred Suksombat et al. (2006) which found that feeding concentrates containing cassava pulp at 35 to 45% DM to lactating dairy cows had no effect on DMI, milk yield and composition. In contrast, Lounglawan et al. (2012) concluded that DM and NELP intake were decreased in the group supplemented with 40% cassava peel in lactating dairy cows, while no negative effects were found on milk yield and composition. Similar result was also found in the study of Hai and Preston et al. (2009) whereby cattle fed with dried cassava root peelings at 0, 0.25, 0.50 and 0.75 kgDM/100 kg live weight linearly increased overall DMI. Holstein Friesian heifers, the results showed BWG were similar in all treatments. However, Chuelong et al. (2011) fed crossbred native cattle with yeast culture fermented FCP and reported improved average daily gain.

**Table 1** Effects of feeding fermented cassava pulp on dry matter intake and live weight change.

Items	Replacement,%			SEM	P-value
	0	20	40		
Dry matter intake (kg/d)	10.09 <sup>a</sup>	10.04 <sup>a</sup>	8.90 <sup>b</sup>	0.19	0.03
Initial live weight (kg)	399	405	414	9.31	0.82

Final live weight (kg)	412	415	422	10.45	0.92
Live weight change (g/d)	414	304	277	122	0.89

Milk yield and milk compositions are presented in Table 2. The results showed no statistical significant differences in milk yield, milk composition, SCN<sup>-</sup> concentration and LP activity ( $P>0.05$ ), which is in agreement with the reports of Suksombat et al. (2006) who reported that feeding with concentrates containing the respective cassava pulp, 35%, 40% and 45% in Holstein Friesian crossbred lactating dairy cows did not improve milk yield (14.2 vs 14.1 kg/d), milk composition and body weight change by the treatments. Although the results of replacement levels of concentrate by fermented FCP at 0, 20 and 40% produced slightly less milk SCN<sup>-</sup> for the activity of the LP system, an LP activity at 1.44 U/mL was sufficient to act as a catalyst for effective stimulation of the antibacterial activity (Marshall et al., 1986). In the current study, diets supplemented hydrogen cyanide (HCN) from fresh cassava pulp resulted in marked alterations in milk SCN<sup>-</sup> concentration, therefore, supplementations of 3.5 and 7.0 kg/d FCP were sufficient to produce the LP activity (mean 8.2 U/ml) in raw milk (Srisaikham et al., 2018). The utilization of the HCN content from cassava pulp and peel in ruminant diets has been found to have potential to extend the raw milk quality by increasing milk SCN<sup>-</sup> levels, due to HCN is transformed to the non-toxic SCN<sup>-</sup> by the action of rhodanese. Previous research has demonstrated that variations in LP activity were probably dependent on many factors including animal feed (FAO, 1993), the individual animals (Fonteh et al., 2002), breed and season (Fonteh, 2006), number or stages of cow's lactation as well as the health.

**Table 2** Effects of feeding fermented cassava pulp on milk yield and milk composition.

Items	Replacement,%			SEM	P-value
	0	20	40		
Milk yield (kg/d)	13.2	13.3	11.6	0.72	0.58
3.5% FCM (kg/d)	13.61	13.6	11.4	0.64	0.31
% Fat	3.72	3.71	3.46	0.06	0.21
% Protein	3.08	3.10	3.00	0.03	0.43
% Lactose	4.34	4.39	4.25	0.05	0.65
% Solid-not-fat	8.16	8.20	7.91	0.08	0.33
% Total solid	11.70	11.79	11.46	0.11	0.48

Fat yield (g/d)	487	487	394	21.25	0.16
Protein yield (g/d)	406	409	348	20.92	0.44
Lactose yield (g/d)	572	580	495	30.72	0.49
Solid-not-fat yield (g/d)	1076	1084	922	57.34	0.46
Total solid yield (g/d)	1541	1559	1323	78.17	0.42
Thiocyanate ion <sup>-</sup> (ppm)	5.49	5.72	5.31	0.52	0.66
LP activity (U/ml)	3.11	3.52	2.94	0.63	0.83

\*LP = lactoperoxidase

## Conclusion

In this work, feeding fermented FCP did not alter milk yield, milk composition and live weight change. However, the lower DM intakes were found in the 40% fermented FCP replacement treatment. For SCN<sup>-</sup> and LP activity, maximum response (5.72 ppm and 3.52 U/ml respectively) was observed at the replacement levels of concentrate by fermented FCP at 20%. Therefore, optimum level rate was suggested at the replacement levels of concentrate by fermented FCP at 20%, because a further increase in replacement levels of concentrate by fermented FCP failed to further increase LP activity in raw milk which can serve as an effective treatment to extend raw milk quality during storage. It is recommended in the present study that the replacement levels of concentrate by fermented FCP at 40% could be beneficial to lactating dairy cows in early lactation. In conclusion, this study expect that the prototype elucidated in this practical research work open up new small holding farmers avenues for beginners to refer while designing their own dietary feeding by product from fermented FCP for dairy cattle of interest.

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# INORGANIC ARSENIC IN RICE AND RICE-BASED PRODUCTS FOR INFANT AND YOUNG CHILDREN IN THAILAND

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## ABSTRACT

Baby rice and rice-based products widely used to feed infants and young children can be the major source of inorganic arsenic (iAs) which was characterized by the International Agency for Research on Cancer as a Class 1 carcinogen. The present study aimed to survey As species content from 80 samples of baby rice, baby cereal and cracker purchased from various retail sources in Thailand. The HPLC-ICP-MS was used to detect concentration of arsenic speciation. The LOD and LOQ ranged from 0.1-4.5 and 5.0 - 9.5 µg/kg rice dry weight (DW), respectively. The recoveries ranged from 97.52 -102.12%. The As(III) species had the highest content from both groups(0.048-0.373 mg/kg). The total inorganic-arsenic content in brown rice was higher than that of white rice. Average value of percentage of iAs in brown rice was 71.24%, and for white rice was 64.11%. Average iAs levels in brown rice (0.081-0.373 mg/kg) was about two fold over the white rice (0.048-0.165mg/Kg). This exclusive high level was considering high risk exposure to baby and toddlers. Majority of the iAs contents found in cereal and crackers are derived from their rice component.

**Keywords:** Inorganic arsenic (iAs), Baby Rice, Rice Cereals, Rice Cracker, Rice-based Products,

## Introduction

Rice is the most widely consumed staple food for a large part of the world's population, especially in Asia. Its ability to grow under flooded conditions promoted not only the capability of taking up more arsenic from soil and water than other plants but also make them having a much higher arsenic concentration than most cereals concurrence with increase their risk to provide arsenic exposure to humans. Arsenic speciation in the rice grain can be presented in higher concentration in inorganic forms: arsenic (arsenite-As (III) and arsenate As(V)) and in only trace amounts in organic forms of monomethyl arsonic acid (MMA) and dimethylarsinic acid (DMA)<sup>1</sup>. The concentration levels of different arsenic species in rice greatly depends on environmental conditions such as soil type, water management and on genotype of the rice plants<sup>2</sup>. Rice produced in Asia shows a strong linear relationship

between iAs and total arsenic concentration, with inorganic arsenic contributing to about 78 %<sup>3</sup>. In humans, inorganic arsenic is extensively methylated, and its metabolites are excreted primarily in the urine within a few days as inorganic As(V) and As(III) and as MMA(V) and DMA(V)<sup>4</sup>.

Inorganic arsenic is associated with many adverse health effects, for example, cancers, cardiovascular disease, diabetes, and immunologic effects. Evidence of chronic exposure to inorganic arsenic associated with cancers in humans comes from studies on the impact of arsenic exposure from drinking-water in many areas of the world including Taiwan, Northern Chile, Argentina, and Bangladesh, where the range of drinking-water concentrations exceeded 100 ppb.

JECFA (2011) and IARC (2012) did epidemiological literature reviews and informed that tumor types most often associated with arsenic exposure are lung cancer, bladder cancer, and skin cancer. The strongest evidence for lung cancer has come from studies in Taiwan<sup>5</sup> and Chile<sup>6</sup>. There is increasing concern regarding arsenic contaminants in rice cereal, which is one of the most common first solid infant foods in the U.S.<sup>7</sup>.

Numbers of studies indicated that children less than 4 years of age are particularly susceptible to neurotoxic effects of exposure to inorganic arsenic. Children consume rice as one of the most common first solid foods. However, this age group is typically a vulnerable subpopulation to arsenic exposures because of a higher food consumption in relation to body weight, higher absorption of metals by the gut, faster metabolic processes, and an incompletely developed detoxification system<sup>8</sup>.

Additionally, early childhood is a period of rapid brain development but not well developed blood-brain barrier which may allow elements noxious to infant health. Arsenic exposure during growth and development can also set up children for other health problems in later life<sup>9</sup>.

At present infant rice-based products are commercially available and widely used during weaning due to its taste, mineral and vitamin requirements fulfill and also low allergic potential<sup>10</sup>.

Recently brown rice made from rice bran and germ tends to be more popular as a wholegrain alternative and believe to have nutritional advantages over the white rice. However they are of particular concern because of having higher levels of arsenic which concentrates in the outer layers of a grain. In brown rice, only the hull is removed. Arsenic concentrations found in the bran that is removed during the milling process to produce white rice can possibly be 10 to 15 times higher than levels found in bulk rice grain. Many concerns have been raised about potential infants and toddlers health risks when baby rice and rice products were made from brown rice. Nevertheless there were lack of studies regarding contents of As species in white and brown and rice product of infant and young children in Thailand.

**Objective:**

1. To determine arsenic species concentration in the variety of commercial baby rice-based products in Thai market
2. To compare inorganic arsenic concentration and profile in brown rice and with that of white rice and study potential hazard exposure.

**Materials**

Commercial baby rice, baby rice cereals and rice crackers were purchased from different popular brands or manufactures at various grocery stores and supermarkets from different locations in Bangkok, Thailand between November 2016 to June 2017. The total samples-survey was 80 samples.

There are 34 samples of baby rice: 12 are the white rice (BR1) received from 6 different commercial brands and 22 samples belong to the brown rice (BR2) also from 11 different producers. For the baby rice cereal products, there are different kinds of cereal types depend on the proportions of rice ingredients in each “recipe”. Some products may have white rice or brown rice or both, and some individual may present in terms of organic and non-organic production. They were categorized into 3 groups according to the components. A total of 22 samples, and 8 White & Brown Cereal with Organic Brown Cereal (RCE1), 6 Brown Cereal with Organic Brown Cereal (RCE2), 8 Organic & Non-Organic Cereal (RCE3). For the baby rice crackers, there are 24 samples, divided into 2 groups, the RCR1-12 samples from 6 commercial brands represent the product of which main composition made from white rice and non-organic produced another group: RCR2-12 samples are labeled as produced under organic standards (majority made from organic white & brown rice).

**Method**

The powdered samples (dry samples) were weighted accurately to a weight of 1.000 g. into glass digestion vessel and put in hot block digestion system , added 15 mL 1.0% nitric acid and vortex 30 sec.(stand in dark overnight). The tightly capped tube was then placed in a preheated block digestion system at 95 ° C for 90 minutes.

After that the sample was cooled, make volume to 25 mL with 2.0 mM Phosphate buffer solution and 0.2 mM. EDTA pH 6.0, and the suspension was centrifuged at 3,500 rpm for 10 minutes. The supernatant was passed through a 0.22  $\mu$ m Nylon syringe filter into brown vial. A portion of the resulting sample solution was transfer to a polypropylene sample vial for arsenic speciation analysis by HPLC-ICP-MS.

To speciate As in rice-based products the diluted 1% nitric acid digestion sample solutions were run on Agilent HPLC- ICP-MS system, with an As Speciation Column (4.6x250 mm), polymethacrylate, Agilent) and Anion Exchange Guard column (4.6x10 mm, polymethacrylate), and mobile phase (2.0 mM Phosphate buffer solution and 0.2 mM EDTA

pH 6.0 ( $\pm 0.05$ ). Isocratic elution with the flow rate of 1.0 mL/min, injection volume of 50  $\mu$ L and run time of 18 min.

Data were presented as mean, median, minimum and maximum. Determined significant differences among samples by T-test for two sample comparisons and one-way ANOVA for comparing the means between the groups. Duncan multiple range test was used to determine statistically significant differences. The statistical analyses performed using IBM SPSS Statistic version 20.0.

## Result and Discussion

### 1. Method validation.

The calibration curves for arsenic species were determined using AsB, As (III), DMA, MMA and As (V) standard with concentration of 0.5 - 30.0  $\mu$ g/kg, the linearity ( $R^2 \geq 0.995$ ). Fortified sample blank by adding standard AsB, As (III), DMA, MMA and As (V). The LOD values for As species ranged from approximately 0.1 - 4.5  $\mu$ g/kg rice d.wt. (n=10), and the LOQ range from 5.0 - 9.5  $\mu$ g/kg. rice d.wt.(n=10). Recoveries, Generally, spiked sample recoveries for AsB, As (III), DMA, MMA and As (V) were excellent, at 3 level concentration 9.5, 254.5, 754.5  $\mu$ g/kg (n=10).The recoveries ranged from 97.52 % -102.12 %

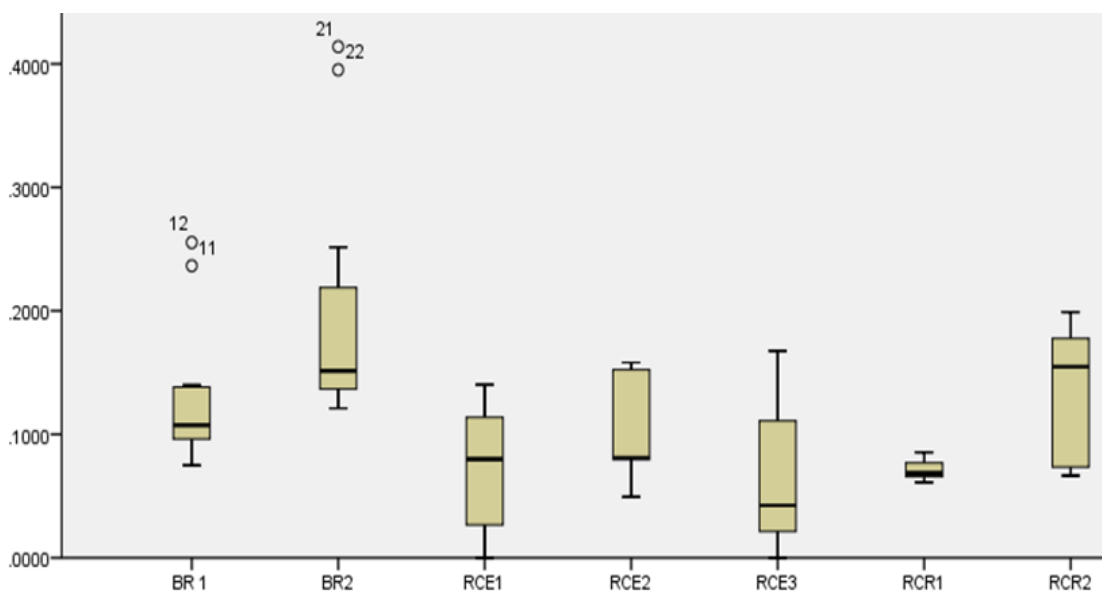
### 2. Total and speciation As concentrations in rice-base products

The total and speciation arsenic concentrations in rice-base products. There was no significant difference between the two duplicates run on each rice- based product sample. All 34 of the rice products tested contained arsenic species, as well as inorganic arsenic (iAs), which is defined as the sum of As(III) and As(V) concentrations as  $\Sigma$  iAs has shown in table 1.

**Table 1** Concentration (mg/kg.d.wt.) of As species in rice-based products (baby rice, rice crackers and rice cereals).

Food category	Type	n	Asi (mg/kg d.wt.)	DMA (mg/kg d.wt.)	MMA (mg/kg d.wt.)	$\Sigma$ As species (mg/kg d.wt.)	iAs (%)
Baby rice	BR1	12	0.066 (0.048-0.165)	0.026 (0.015-0.073)	0.004 (0.000-0.023)	0.108 (0.075-0.255)	64.11 (47.25-84.76)
	BR2	22	0.120 (0.081-0.373)	0.028 (0.005-0.071)	0.008 (0.000-0.028)	0.151 (0.121-0.414)	71.24 (53.26-92.47)
p-Value			0.022	0.962	0.666	0.035	0.013

Rice	RCE1	8	0.057	0.002	0.000	0.080	68.80
Cereals			(0.000-	(0.000-	(0.000-0.000)	(0.000-0.140)	(0.00-89.81)
	RCE2	6	0.099)	0.046)	0.000	0.081	79.70
			0.065	0.016	(0.000-0.010)	(0.049-0.158)	(70.01-87.73)
	RCE3	8	(0.034-	(0.013-	0.000	0.043	87.41
			0.139)	0.024)	(0.000-0.002)	(0.000-0.168)	(0.00-100.00)
			0.032	0.005	0.321	0.492	0.279
p-Value			(0.000-	(0.000-			
			0.148)	0.023)			
			0.482	0.228			
Rice	RCR1	12	0.043	0.027	0.001	0.069	59.91
Crackers			(0.034-	(0.022-	(0.000-0.003)	(0.061-0.085)	(56.17-70.72)
	RCR2	12	0.059)	0.034)	0.001	0.155	74.56
			0.115	0.028	(0.000-0.013)	(0.067-0.199)	(65.25-82.23)
p-Value			(0.044-	(0.020-	0.022	<0.001	<0.001
			0.159)	0.035)			
			<0.001	0.662			



**Figure 1.** Boxplot with lines representing median, 25th and 75th percentiles, whiskers 10th and 90th percentiles and dots outliers for iAs in baby rice, rice cereals and rice crackers samples. BR1-Baby rice-White rice, BR2-Baby rice-Brown rice, RCE1-White & Brown Cereal with Organic Brown Cereal, RCE2-Brown Cereal with Organic Brown Cereal, RCE3-White Cereal &

Non- Organic Cereal , RCR1-Rice Cracker from white rice organic, RCR2-Rice Cracker from white & Brown rice organic.

### Baby rice

The comparison between total As species, total iAs, DMA, MMA and % of iAs in rice-based products from published data and our study is shown in Table 2. The total As species concentration ( $\Sigma$ As) in baby rice product from our study ranged from 0.075 to 0.414 mg/kg. The As(III) species had the highest content from both group(0.048-0.373 mg/kg), DMA the major organic As species takes the second highest concentration (0.005-0.073 mg/kg), the MMA level is very much less or near the detection limit. The Arsenobetaine(AsB) are scanty found or not detected. The percentage of iAs content in brown rice (mean value of 71.24%, range from 53.26 to 92.47) is greater than that of white rice (mean value of 64.11%, range from 47.25 to 84.76) (Table 1). Likewise the median value of iAs concentration of brown rice 0.120(0.081-0.373 mg/kg d.wt.) is nearly two-fold over the white rice. This shows that the brown rice in particular to that high percentage level of inorganic arsenic (eg. iAs 92.47%) would be above the JECFA proposed iAs maximum level for brown rice (0.35 mg/kg). This is similar to previous studies showing that brown rice contains higher proportion of iAs than white rice, which is mainly concentrated in the pericarp region at surface of the whole grain. Though whole grain products were claimed to have more nutritious and healthier, it is of particular concern that they may associated with exposure risk by their high levels of iAs which may exacerbate health risk for infants and young children.

**Table 2.** Concentration (mg/kg DW) of As species in rice-based products (baby rice, rice cereals and rice crackers ) from USA (FDA survey), EU (Antonio J., 2016) and Thailand

Category	n	Concentration (mg/kg Dw),average (range)				Total Species	As % iAs (by speciation)
		total iAs	DMA	MMA			
Baby Rice	US	85	0.114 (0.039-0.254)	0.071 (0.015-0.204)	0.003 (0.001-0.012)	0.215 (0.550-0.341)	65.5 (22.0–82.9)
	EU	29	0.121 (0.056-0.268)	0.041 (0.023-0.123)	0.001 (0.001-0.004)	0.175 (0.084-0.334)	69.8 (51.4–84.6)
	Our Study	34	0.120 (0.048-0.373)	0.034 (0.005-0.073)	0.008 (0.000-0.028)	0.168 (0.075-0.414)	69.95 (47.25-92.47)
Rice	US	105	0.091	0.042	0.001	0.135	63.0



cereals			(0.023-0.283)	(0.007-0.493)	(0.001-0.014)	(0.041-0.625)	(18.8–87.7)
	EU	53	0.075	0.037	0.001	0.119	70.6
			(0.008-0.323)	(0.005-0.081)	(0.001-0.004)	(0.042-0.396)	(14.2–89.6)
	Our Study	22	0.061	0.015	0.001	0.077	76.51
			(0.000-0.148)	(0.000-0.046)	(0.000-0.010)	(0.000-0.168)	(0.00-100.00)
Rice	US	199	0.079	0.034	0.001		
Cracker			(0.008-0.273)	(0.001-0.477)	(0.001-0.021)	0.116(0.012-0.657)	65.1b
s							(18.4–97.6)
	EU	97	0.111	0.025	0.002	0.141(0.019-0.328)	80.9a
			(0.018-0.211)	(0.001-0.172)	(0.003-0.013)		(44.8–100.0)
	Our Study	24	0.074	0.027	0.002	0.103(0.061-0.199)	68.10
			(0.034-0.159)	(0.020-0.035)	(0.000-0.013)		(56.17-82.23)

Comparative profile of the three baby rice-based products are displayed in Figure 1. The 2 dot-out-liers in white rice code 11,12 and in brown rice code 21, 22 had the highest iAs concentration of each category were actually sold in concentrated form. The US FDA and the EU dataset on iAs in rice and rice products from the US and EU market revealed the median and range of iAs are 0.114 (0.039-0.254) mg/kg and 0.121(0.056-0.268) respectively which were no statistical difference from our studied results (Table 2). However the predominant DMA content found in US rice 0.071 (0.015-0.204) were nearly two-fold higher than ours samples 0.034(0.005-0.073) Likewise, rice from the US market seems to have total summation of As species concentration (median of 0.215 mg/kg) higher than those from the EU market (0.175 g/kg) and from our study group (0.168mg/kg).

### Rice cereals

The median value of iAs concentration in 22 rice cereal samples belonging to different commercial brands is RCE1=0.057, RCE2=0.064 and RCE3=0.032 mg/kg (Table 2). These values are much less than the U.S. and EU products and far from JECFA proposed iAs

maximum level. As pointed out in the section on baby rice this is associated with the common inclusion of whole grain rice to produce organic products.

There is no statistical difference within groups and between groups of iAs, their percentage, and the summation of As species concentrations.

### 3.3 Rice crackers

In rice crackers, the white and brown rice organic product-RCR2 was mainly contributed from iAs, its median dry weight concentration value (0.115 mg/kg) is higher than the RCR1 (product made from white rice non-organic group) 0.043 mg/kg. Similarly the total arsenic speciation value of RCR2 (0.155 mg/kg) is more than two-fold over the RCR1 (0.069 mg/kg). The iAs percentage comparison between the two groups of products (74.56% over 59.91%  $p < 0.001$ ) rather confirmed evidence from the fore mentioned that brown rice carry more inorganic arsenic concentration than the white rice. This result also shows a good correlation with the rice content which means that most of the iAs is coming from the rice.

### Conclusion

Baby rice products are widely used during weaning and feed young children. Our study explored scientific evidence on amounts of inorganic arsenic in rice-based products for infants and toddlers. It was found that brown rice-based products had the highest iAs concentrations especially those usually labeled as produced under organic standards. The iAs concentration found in some samples were higher than the JECFA maximum level.

However, most of the baby rice-based products from Thai market had lower levels of iAs concentration than rice cereals from the EU and US markets.

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# THE APPLICATION OF CREATIVE TRANSFORMATION PRINCIPLE IN THE REVIVAL OF TRADITIONAL CHINESE CULTURE TAKE THE QUALITATIVE ANALYSIS OF I CHING'S MATERIALISM AS AN EXAMPLE

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## ABSTRACT

The Central Committee of the Communist Party of China and the State Council have adopted the policy of "comprehensive rejuvenation of traditional culture" as a major national policy. How we can truly carry out the creative transformation and innovative development of traditional culture while adhering to dialectical materialism and historical materialism, so that the most basic cultural gene of the Chinese nation is still adapting to contemporary culture while coordinating with modern society, have become a great challenge to the cultural researchers. Scholars of the Marxist philosophy of the Yi-ology school conducted a bold exploration of combining the basic principles of dialectical materialism and materialist dialectics with the Yi-ology and philosophical system. They tried to combine literature, qualitative analysis and reverse thinking as well as the systematic logic analysis and reasoning method. They demonstrated that the I Ching's materialism is a kind of materialism that has a distinct feature of the core of the dialectical materialism. This has changed the long-established conclusion that the academic circles have long belonged to simple materialism. It is an active, effective and rigorous scholarly research of how traditional Chinese cultural genes represented by I Ching are compatible with contemporary culture and how they are coordinated with Marxist philosophical theory of modern Chinese society.

**Keywords:** Traditional culture, I Ching, Simple materialism, Dialectical materialism

## Chapter 2 Introduction

### 1.1 Background of the Research

I Ching, one of the oldest Chinese culture classical books, which is one of the important components of The Four Books, is crystallization of wisdom of the Chinese Nation and honored as "The head of scriptures, the source of nature". In modern times, especially after Marxist Philosophy enters China, the dispute over I Ching in philosophy attribute has been continuing up to now. For example, whether I Ching is the outcome of materialism or idealism? Whether I Ching propagandizes the superstition and mystical power or not? Whether materialism of I Ching in simple materialism stage or not? Whether materialism of I Ching is simple dialectical materialism or not? How about the exact depth and content of

materialism of I Ching? These existing disputes reflect the deficiency in the study of the systematism of I Ching to a great degree, at the same time, which reflects the research outcomes that I Ching is insufficient in publicity, in focusing in controversial events and popular application. With the central government put forward three requirements of "accelerating the construction of philosophy and social science with Chinese characteristics" (Xi,2016), Philosophy with Chinese characteristics should "reflect the inheritance and nationality; reflect the originality and times; reflect systematisms and professionalism" (Xi,2016), meanwhile, with the basic principle proposed "in terms of guiding ideology, discipline system, academic system, discourse system and so on, should fully embody the Chinese characteristics, Chinese style, Chinese sprits." (Xi, 2016) The ancient Chinese classical philosophy, including I Ching, opened a new journey of innovation. At the same time, under the significant task of promoting Chinese philosophy and social sciences, that is, "continuing to promote the Marx philosophy sinicized, modernized and popularized, continuing to develop the Marxism in twenty-first Century and Marxism in contemporary China " (Xi,2014). Marxist theory research scholars are trying to combine China and classical philosophy to seek the path of sinicization. It is under the dual influence of this internal cause and external cause, the innovation and recreation of Chinese classical culture represented by I Ching and how to carry forward Chinese excellent traditional culture has become a research focus. For contemporary Chinese the issue that, "it enables the basic cultural gene of Chinese nation adapt to the contemporary culture and be in harmony with modern society" (Xi,2014), not only concern the reflection of the core and top comprehensive national power which is cultural soft power, but also related to "the cohesion of a nation's sprits" (Xi,2014), to "the confidence in our paths, in our theory and in our system" (Xi,2014) as well as our culture which is the most fundamental.

Specific to this topic, the research results of the predecessors' on the subject of materialism of I Ching, both at the theoretical level and at the practical level, are very few. What's more, the existing research results are basically not to study further or deeper, lack of systematic and in-depth results. Thus, we can conclude that research in this field is at an early stage. There is a relationship of inheritance between this research and Meng's (2006:152-154) research on the contradictory theory of I Ching in China. In his previous research, he "reveals the basic idea of materialism and dialectics in I Ching; demonstrates the scientific and advanced ideas and theories of a series of contradictions in I Ching; finds out the evidence that I Ching adopt the deductive method to analyze contradiction; demonstrates the fact that I Ching adopt the deductive method to study the objective world and answer the long-standing dispute in academia about I Ching" Meng (2006). I

Ching's materialism in this research mainly makes the elements in I Ching systematic and structured. From the essential difference between concepts to make a conclusion that I Ching materialism is not simple materialism, but it is materialism which has the characteristics of dialectical materialism. Hence, it enables us to know that I Ching materialism is scientific and advanced. Although there is no successive or supplementary relationship with other name-relevant researches, the author will analyze and comment on the core view of the relevant research literature, and finding out the existing problems to refute contradictions with proofs. The foundation and framework of the research are established by the author in accordance with the basic principles of I Ching and dialectical materialism and materialist dialectics.

## **1.2 The purpose and significance of the research**

The purpose that the author chooses this research embodies in two aspects: first, to put forward general and explicit view in line with the scientific cognition and give a correct judgment through the scientific and systematic analysis of the dispute on the contents of I Ching and materialism for a long time. Secondly, to lay a good foundation for the future researchers of I Ching through systematic research on I Ching itself (rather than through the study of relevant literature review of I Ching) establishing a relatively perfect principle system of I Ching materialism. The significance of this research lies in three aspects: First, the author through systemic argumentation, demonstrates that I Ching materialism is not the simple materialism, and this demonstration itself has epoch-making destructive significance, which can fundamentally change the conclusion that ancient materialism generally belong to simple materialism for the longest time in academia, where it considers materialism of I Ching and ancient simple materialism fall in the same category. Second, the author gives a clear positioning of I Ching materialism through all factors system, which answers what type of materialism is in I Ching and what characteristics I Ching materialism possesses on earth, and these characteristics determine the uniqueness of I Ching. There are two dimensions, "breaking" and "establishing", in this research. That is, using the way of refuting to demonstrate that the reason why I Ching is not simple materialism, by way of argument to determine that what kind of materialism is in I Ching, which has duality of "breaking" and "establishing". Therefore, this research can build a relatively complete and reliable I Ching dialectical materialism platform for the future researchers of the I Ching. It can prove that I Ching perfectly can be one of the reliable Chinese classical theories that depends on in the process of sinicization of Marxism. Thirdly, the author through mining the deep-level materialism thought system in I Ching to actively fulfill the requirement of "constructing the discipline system of philosophy and social science with Chinese characteristics, academic

system, discourse system and enhancing the international influence of philosophy and Social Sciences in China” (Xi, 2017) and to accelerate the building of “Philosophy and social science system with Chinese characteristics which presents inherited, national” (Xi,2016). The method of systematically combing traditional culture to actively research and explore in the Chinese classical philosophy theory, "make the cultural relics collected in Forbidden Palace, the heritage displayed in the vast land, the text written in ancient books alive" (Xi, 2014), which fundamentally enhance cultural confidence of the Chinese nation.

### 1.3 The main issues of the research

Question 1: Does the I Ching materialism belong to simple materialism?

Question 2: What kind of I Ching materialism is? Does I Ching materialism possess historical materialism and dialectical materialism?

### Chapter 2 Literature review

The author finds that the literatures with a positive correlation in the study of I Ching are quite rare through the author’s research of the existing literatures. The so-called positive correlation means that it has a direct relevance with the author’s research content, and has some similarity with some of the elements within the scope of the research topic. There is no research which is the same in the topic and the purpose with this research is through searching the existing literature database. Basically, in the direction of the I Ching materialism both at home and abroad, there is no high-level academic research achievements consistent with this research content and purpose were published. The literature review mainly selects the literatures which have high relevance with this research's content and scope to make a thorough and pertinent comment.

To the question whether I Ching materialism belongs to simple materialism or not, Hou (1988:1-6) believes that I Ching materialism is the result of theory of reflection, however, in the class society, it is developed in the direction of idealism and agnosticism. In other words, he believes that the I Ching materialism belongs to the category of simple materialism, but part contents of I Ching possess idealism and agnosticism. Qi (2007:129) thinks that I Ching sums up historical lessons and those historical lessons which are edited into Yao Ci taking in the form of stories just omitted the time and character of divination and are vaguely recorded in the Gua, so I Ching “is shining the light of materialism from the beginning to the end”. What Jin (1998:107-111) mainly talks about, is the dialectics of I Ching, not the materialistic dialectics of I Ching. His main research method is “using scripture to explain scripture”, which means to interpret Yao Ci by choosing the other Yao Ci or relevant contents in I Ching to explain as far as possible. This method is often used in Christian missions, that is, to interpret the Bible by using Bible content. In his research, he points out

that there are concrete form of the law of unity of opposites in Zhou Yi, as well as the law of quality and quantity and the law of negation of negation. However, his research didn't study further and deeper since he didn't study in the level of constructing dialectic system of I Ching. What's more, there is no fundamental solution to the dialectics of I Ching that whether it is materialistic dialectics or idealistic Dialectics. (Gao & Shi, 2002) Gao & Shi (2002:106-107) believe that the philosophy of I Ching can prove that I Chang is unified with materialism and dialectics. I Ching discusses the cosmic view of "one divides into two" and the unity of opposites through the form and method of Yin and Yang Eight Diagrams. (Gao & Shi, 2002) They think that the two symbols of Yin and Yang in I Ching can represent all things in the universe, and it's the first time to put forward in the Chinese ideological history that the universe is divided into two categories, namely, opposites and unity, which is the representation of the earliest dialectical thought as well. (Gao & Shi, 2002) It is worthy of recognition that using the thoughts to discuss the relation of Yin and Yang, but there is no sufficient reasons in their research to discuss that Yin and Yang can be the representative of the universe. Meanwhile, it is not rigorous in their discussion, and even there is a controversy and wrong statement that "Yin and Yang are the unity of two conflicting aspects of everything". As we know, contradiction is the unity of opposites, and Yin and Yang are two aspects of contradiction, so there is a unity of opposites between Yin and Yang. Thus, the study of the unity of Yin and Yang is a study of the unity of contradictions between Yin and Yang. However, the authors didn't give a convincing explanation on the identity of Yin and Yang, just simply believes that everything has Yin and Yang, and that the concept of Yin and Yang is contradictory". The thinking core of the unity of opposites of Yin and Yang is the philosophical thought of contradiction and unity, as well as the foundation of the movement of all things. This kind of conclusive judgment is lack of rigorous demonstration process in their research. Therefore, this conclusion is without rigorous academic significance. In addition, the Yin and Yang is interpreted as the movement law of Yin and Yang when the authors explain the law of change and it is concluded that the understanding of the universal law on the movement of Yin and Yang movement belongs to the typical view of simple materialism. Their research finally falls into the conclusion of simple materialism and simple dialectics, and the ultimate goal of their research is not realized.

In the research field of dialectics and I Ching, Du (2009) has a systematic research, and his mainly aims at exploring the problem of Marxism in China. He thought that *Zhou Yi* marked by complexity and richness of principle of dialectical materialism. Therefore, the critical succession and creative interpretation will be very important to "Zhou Yi", and so that the commons between *Zhou Yi* and the philosophy of Marxism can be found. Du



Xiaoan thinks the "Zhou Yi" is ancient and simple dialectical materialism "the law of both opposites and unity of all things in the universe are explained by Yin and Yang dialectical thinking method all along, and the core problem is the unity of opposites." Du Xiaoan quoted from the I Ching *Xi Ci* said: "observe the sky and earth, and observe the feather of the birds and beasts, as well as observe the mountain and river. Ba Gua explains all the things in universe and human ethics." This is how Chinese ancestors explore the objectivity of the world. Moreover, Du Xiaoan got the new conclusions from his I Ching research, which is "The world is materialistic, including human society." But this conclusion lacks of evidence, it is a speculation and over-understanding of I Ching, which will lead to misunderstanding of I Ching's concept.

Guo Moruo, the pioneer of Marxist philosophy - I Ching school, who was the earliest individual that utilized historical materialism and dialectical materialism theory to study I Ching, had begun his research combining Marxist philosophy and traditional Chinese culture since 1920s. Guo Moruo thought that "the root of concept of *Zhou Yi* is the opposite of Yin and Yang. Everything is formed by such opposition, and the universe is full of contradictions "<sup>1</sup>, "The universe is a process of change, a movement, so the name is Yi." This view combines the change that I Ching studies with the movement of materialist dialectics, which has a great progress.

Meng (2006: 152-154), who early uses the principle of materialist dialectics of Marxist Philosophy to study I Ching in China, made it clear that the cosmos outlook of I Ching is the cosmos outlook of materialist dialectics. At the same time, the forecasting thought in I Ching is explained and the basis of divination is found by Meng Wei, and he demonstrates that "Yao Ci is the product of human objective practice, which is gradually formed by induction." He also clarifies and effectively discusses the important basis of existence that deductive method in I Ching. Meng Wei demonstrates that "Duan - Gua Method", the method that applying I Ching to forecast, embodies humans use deductive method to know the facts of the world. As well, he put forwards that I Ching is the unity of induction and deduction. Meng Wei cited "To predict the future using the change of numbers to deduct as ultimate as possible called "Zhan"; understanding the way of change called "Shi"; The change of Yin and Yang cannot be measured, so we called it "Deity (Shen) " from Xi Ci, as evidence to prove there is no mystical thought and propaganda about idealism, "Deity (Shen) " in Xi Ci just one kind of expression method of metonymy. Meng Wei is the first one who rigorously expounds that I Ching reflects the relationship between the primary and secondary contradictions of dialectics, and who analyzes that Tai Ji shows the material motion attributes of absolute motion and relative motion, and Tai Ji contains the principle

of mutual quality change. At the same time, the phenomenon of "Tai Ji deviation" is put forward, and the principal aspect and secondary aspect of contradiction are further studied. Meanwhile, Meng Wei does the research on the contradiction of unity and conflict in "I Ching Tai Ji", "Nei Gua", "Wai Gua" and *Xu Gua Zhuan*. Except theoretical research, Meng Wei applies his research achievements to the analysis of human nature and proposes three states: I Ching Tai Ji and human nature balance, human deviation and human bias. And then Meng Wei analyzes the human nature element structure by using Tai Ji theory, therefore he concludes that "Tai Ji Yang Yi 49 representing human nature structure elements", "Tai Ji Yin Yi 51 representative elements", "based on Yu's eyes of Tai Ji Yin Yang Yu, Yin inside Yang, Yang inside Yin then created 11 elements which can transform the human nature represent". He uses Marxist philosophy and Chinese traditional culture - I Ching to make a certain contribution in his research field and to do a creative interpretation of I Ching.

## Chapter 3 Research Method

### 3.1 Research Object

This research applies the Marxist philosophical theory, which is an innovative research in the field of Chinese philosophy. The main objects of this study are I Ching and Materialism, which are related to contents, Simple Materialism, Dialectical Materialism and Historical Materialism, and Materialist Dialectics. The result of this study has an important and positive effect on the construction of the system of Chinese Social Sciences, academic, and Discourse, which enhances the impact of Chinese Philosophy in the world.

### 3.2 Research Data Collection

In the study, the author widely collects the representative core literatures which are closely relating to the subject of I Ching and materialist dialectics. Firstly, according to the research direction of this paper, the literature collection method and the collection path are determined. Secondly, retrieve the relevant books and select the books that meet the needs of the research.

What's more, the relevant literatures, short articles that are not formally published or only views on the Internet should be widely retrieved and then the related contents should be preserved and studied.

The following is the literature search process:

First, the study conducted an extensive cross-language literature review of the literature that are related to this research

Second, a relevant literature research was conducted. The retrieval method is as described above. The author, Meng Wei, searched more general keywords, "I Ching Materialism" and "I

Ching Dialectics”, which brought up a few literatures. The author downloaded the literature and carried on an in-depth study.

Third, Retrieve the related books and determine the relevant versions to order. Last but not the least, Retrieve [www.people.com.cn](http://www.people.com.cn), which is the important speech database of President Xi. The problems that the author studies in, sinicizing of Marxist philosophy and the unscrambling Chinese traditional culture with Marxist philosophy, is the controversial issue advocated by the central government.

### **3.3 Research Design**

In this study, the author uses qualitative research method, which includes qualitative analysis of literature, reverse thinking method, system logic analysis method with organum. The reason for the combination of those above research methods is that this research is integrated and innovative study of different philosophical systems. This kind of study integrates two different philosophical systems of Marxist philosophy and I Ching philosophy, and applies dialectical materialism and materialist dialectics to give a creative and sinicized interpretation of I Ching. Objectively, it requires the author to apply various methods in the design of research methods to find out the falsehood of existing research, and correct these mistakes, and finally draw the correct conclusion.

#### **3.1.1 Qualitative Analysis of Literature**

In this study, the premise of literature analysis is to ensure the reliability of the sources of literatures and the contents involved. At the same time, we need to sort out the data related to the literatures and research topics, and then explain their inherent logical relations. First of all, the author retrieves the highly relevant literatures to research topic to classify, sort and number in accordance with the issues involved. In the process of collating literatures, it is necessary to identify the references in the literature reviews, and quotations in the text should be traced back the original literature to be checked, once garbles and inaccuracies are found, the author will mark them. This process can guarantee the reliability of the reference literature obtained by the author. Second, the author further confirms the relationship between the reference and the subject of historical materialism and dialectical materialism of I Ching. Understand the internal logical relationship of those literatures and clarify the relationship between simple materialism and I Ching materialism by carefully and repeatedly analyzing the initially sorted numbered literature materials, so that one stable, reliable and accurate concept can be induced, and then base on these concepts, it forms reasoning, which is the basic view of point of the author.

Thirdly, the author thinks seriously about the relationship between the basic viewpoints, the content that viewpoints reflect of the research and the research subject, and author further

clarifies the essence of the subject and its logical level and logical order, so that theoretical framework of the subject in this study formed. Finally, the basic framework of the study is initially determined. In this step, the author based on the formation of the theoretical structure makes a further selection from the relevant literatures with I Ching, materialism and dialectics and choose the components, which are of great application value, extensive and aculeate enough to reveal the essence of things through repeated comparison, to make a confirmation. Through this process of from outward appearance to inner essence, discarding the dross and selecting the essential, it is finally formed the content framework of this research, which at the same time combines with theoretical framework to form whole basic framework.

### **3.1.2 Qualitative research**

In the study, the author determines the essence of things involving I Ching, Zhou Yi, simple materialism, dialectical materialism, Tai Chi, Ying Yang in accordance with the requirements of qualitative research which is in accordance with qualitative research requirements. Search the Chinese authoritative dictionary named "Ci Hai" to find the concept or definition that can reveal the essential characteristics of these things, author tries to comprehensively and intensely investigate and analyze these concepts and appearance of things, and then correctly reveals inherent law that can determine the movement, change, and development of these things. In the study, the author pays more attention to the theoretical exploration on I Ching and materialism, to the combination of the history, the development status trend of materialism and dialectics.

### **3.1.3 Reverse thinking method**

In this paper, the author determines the research questions by adopting the shortcoming reverse thinking, which means shortcomings become available things. The author starts with finding the possible cognition loophole of scholars that caused by the effects of traditional thoughts and knowledge structure, then the author gradually ravel out the relating problems to explore the prototype of things. Most scholars believe that I Ching materialism belongs to the category of simple materialism because of Chinese traditional philosophy education concerning the theory that Chinese ancient materialism belongs to the simple materialism. The author finds the possible wrong cognition, and then by checking the corresponding literature and combining the concept of simple materialism to confirm that the above concept is the real cognition mistake, which is an overturning discovery. Meanwhile, the author applied conversion type reverse thinking method, which means the way of solving the problems is hindered, and it is possible that the research

objectives cannot directly achieve. Converting the original problem into another problem and using other means or changing the direction of thinking can solve the problems smoothly. The author encounters the corresponding obstacle, which is I Ching does not address the problems conforming to the concept of material of Marxist philosophy, in the process of studying the definition of I Ching. In this case, it is necessary to convert this problem into substance properties to carry out the paper validation and then find out the concept of substance.

#### **3.1.4 System logic analysis**

The author chooses to use the method of system logic analysis to retrieve literature that are related to historical materialism, the dialectical materialism, and I Ching original system and clarify the research questions. The use of systematic logic analysis helps to find the core elements and core structure of the theory in the literature quickly, and then to choose the optimal plan that exploring the core of materialism of I Ching.

#### **3.1.5 Reasoning method**

Reasoning method is logical derivation method, which refers to the logical thinking method “on the basis of mastering certain factual data and things related information, a new conclusion is finally given through logical relations and gradual deduction” The author starts with the proposed conclusion that I Ching materialism is not simple materialism by using Generalized Modus Tollens to deduce the prerequisites are required if this conclusion is established, and then the relevant conditions are gradually met in the study, and the author turns the research hypothesis into the conclusion. Meanwhile, the author applies conventional reasoning method and induction reasoning method as well.

### **Chapter 4 Research results**

#### **4.1 the study of the nature of the materialism of the I Ching**

In ancient of Chinese theory of the Five Elements, the “Wu Xing” also known as the Five Elements, which are Wood (mù), Fire (huǒ), Land (tǔ), Metal (jīn), and Water (shuǐ). It is widely accepted in the field of Academia that materialism in the I Ching is typical of naive materialism. There is not enough evidence to show that The "Five Elements" or other material to explain the origin of the world, which due to it is not belong to features of simple materialism. Based on the origin of the theory of "Five Elements", the earliest origins of the “Five Elements” are a way to calculate in astronomical observation. That was calculating five hours in the astronomical calendar. The author believed that the "Five Elements" is only a categorization method for expressing and distinguishing specific morphological attributes of different substances, which is an innovative research method.

The purpose of this paper is to study the relations of mutual generation and restriction between the specific forms of the Five Elements represented by the Five Elements. It is lack of basis of thinking “Five Elements” as use the "Five Elements" Theory as an Ancient Simple Materialism to explain the origin of the world in concrete form. Thus, this paper studies the relationship of “Five Elements”. In the case of unfounded, it is wrong with intuition and subjective imagination come to the conclusion that over subjective.

I Ching does not have any of the characteristics of simple materialism. The author proves that I Ching does not have a specific form to explain the origin of the world. Besides, I Ching does not regard the "Five Elements" as the origin of the world and I Ching denied the Creationism. The "Deity " in the I Ching is a metonymy. This is a saying of the book, *Copulative*, this is called the “Deity” when the changes in yin and yang cannot be predicted. Beside, this is a saying of the I Ching ,we call “Dao” when the "Yin" and "Yang" is existing (Wang, 2014). However, I Ching has never considered "Yin" , "Yang" and “Dao” as the origin of the world. In the traditional concept, the two opposite sides in everything were Yin and Yang. We can conclude by reasoning that Yin and Yang of I Ching are opposite of the contradictions, which is mentioned in materialist dialectics. This is that we call “Dao” when the "Yin" and "Yang" exists (Wang, 2014). It named "Dao" when "Yin" and "Yang" were showed at the same time, which is named “contradiction”. We can conclude that "Dao" is opposite of the contradictions mentioned in materialist dialectics, which is named “contradiction”. The description of the two points above is highly consistent. Through comparison and reasoning, we can conclude that the "Dao" of the I Ching is “contradiction”, which is original and it is the author's first proposal.

This is not confused with the concrete forms of material and material. "Sky” and “Land" of I Ching refers to all things (universe), belonging to the highest abstract category of philosophy, which is basically consistent with the Engels’s theory that “material” is the sum of all kinds of things". This is basically consistent with the concept of materiality in Marxist philosophy. The I Ching epistemology belongs to the use of inductive method has formed, which was beyond perceptual knowledge that is to stay on the surface of this phenomenon and external knowledge, and this is the stage of rational understanding that has entered the concept of setting, judging and reasoning. The theories of I Ching materialism have no elements of simple materialism, which is neither the ancient simple materialism nor simple materialism.

**4.2 We confirmed the I Ching materialism is what kind of materialism and whether it has the research results of the materialism dialecticals and the nature of historical materialism.**

**4.2.1 The research results of the movement concept of dialectical materialism of I Ching.**

There are "not easy"(bù yì), "change easy" (biàn yì) and "simple"(jiǎn yì) in I Ching, which is named as "three Yi". The I Ching is studying "changes", and research content is the change of yin and yang. "Yin" and "Yang" are the two opposing principles in nature. The change of "Yi" is corresponding to the philosophical concept of "motion" form of dialectical materialism, and it is the motion form of material. Materialist dialectics hold the view that "time and space are forms of physical existence of motion "(Mu, 2014)." Motion is the fundamental nature of material and the way it exists." (Mu, 2014) "Motion refers to all the changes and processes that take place in the universe." (Zheng, 2013). It can be determined that the "Yi" in the Book of Changes states "Motion" (including change and development). The author of "three easy" to interpret a principle of motion, it is the eternity of motion, change and development. It is eternal that the objective world is always in motion, changes in development. Various forms of exercise can be transformed into each other, but the motion is eternal. It is impossible to create something out of nothing or from being into nonbeing. Material motion cannot be created and destroyed. This is called "Not easy". "Change easy" refers to the diversification and complexity of the motion forms, and the transformation of various motion forms under certain conditions. "Simple" refers to the objective movement of things, change and development, which are regular. Motion contains every change; change reveals specific content of motion.

"Simple" refers to the objective things of the motion, change and development are regular. As long as we can understand the relationship between motion, change and development, the rules of motion, change and development can be grasped, and it will be easier to solve the question of change. "Born"(shēng) means the "motion" (including change and development). "Born" caused the motion process is as follows: the combination of Yin and Yang creates the "Eight symbols" The modes of "Eight symbols" generated "Sixty-four symbols". The Sixty-four symbols generated the Three hundred-Eighty-Four symbols, which is interpretation of all things motion (including change and development) and statement and the relative and unified process of movement (including change and development). It is particularly pointed out that the above is the author's first interpretation of the way in the area of international studies

## 4.2.2 The study finding of “Concept of time and space” of materialistic dialectics in I Ching

### 4.2.2.1. The findings of relationship between “Yi”, “The universe”, “Sky and Land”, “Time-Space”

“Yi” is belonging to concept of “motion” of materialist dialectics. We made some reasoning and argument of the meaning of “sky and land”. In ancient Chinese philosophy, “Yu” refers to the general term of space. In the book *Mo Zi Jingshang*, “Yu” included all the different places. It is also meaning that that ‘Yu’ included everything. (Xia & Chen, 2009) “Yu” is the general term of space, “Zhou” is the general term of time. “Yu-Zhòu” means general term of “sky and land”. *Huainan Zi Yuan Dao*: (‘Maintain the universe and make the sun, moon and stars shine’. Gao You annotation for it) “Up and down on all sides” called “Yu”, and “Throughout the ages” called “Zhou”. This is called “Yu Zhou”. Based on the study of Xia and Chen (2009), we can conclude that the “Yu Zhou” in ancient Chinese philosophical area is “sky and land”. “Yu Zhou” is also a general term for everything in the world. Based on “Yu Zhou” means “Time-space”, we can infer that “sky and land” and “Time-space” are inseparable. The book, *Xu Gua Zhuan*, confirmed the “sky and land” is full of everything.” The relationship between “Yu Zhou”, “sky and land”, “the universe”, and “space-time” becomes very clear. Based on meaning of space-time is obtained from the separate analysis of “Yu” and “Zhou”, the author thinks that “space-time” is a way of existing in motion forms or in “sky and land”, forms, which is the material motion form in the abstract philosophical concepts. “Yu Zhou” means everything in the world, and “sky and land” also. The “Yu Zhou” and the “sky and land” and the “motion” and the “material” are the same abstract categories of philosophy, which is distinguish from the material motion forms, which is highly consistent with the meaning of material of materialistic Philosophy. The academic, Engels, saying that “material is the sum of the everything in the world.” which is based on conclusion above. (Xia & Chen, 2009). The concept of “sky and land” in I Ching is basically the same as the concept of “material” in materialist dialectics.

### 4.2.2.2. Conclude the study findings of the relationship between “sky and land” (material), “movement” and “Time-Space” of Dialectical materialism of I Ching

The book, *Xi Ci of I Ching*, indicated that “Yi” and “sky and land”, which generated the world” (Zheng, 2013). “Yi” means the concept of “material” in materialist dialectics. “When the changes of Yin and Yang are normal and reasonable, we need to comply with them. However, if the changes of the yin and yang being over or under condition, we should



sanction and standardize it, which is based on the rules of the sky and land. Besides, The God is invincible.” This reflects the principle of the relationship between materialism and space-time in the I Ching. "Yi" means “motion”, “change” and “development” are studied based on “sky and land” (material). Therefore, "Yi" includes the rules of motion, change and development of “sky and land”. “Yi Li” includes motion, change and development of “sky and land” (i.e. material), which was not deviate from the motion of “land and sky”. This shows the diversity of the concrete forms among all things. We pointed out the mysteries of Yin and Yang is contradictory and unity. So the people, who can realized the relationships the mysteries of Yin and Yang, realized the time and space of motion forms of "sky and land" is infinite, eternal and is not belongs to a fixed space. “Yi” means motion, change, and development, which is an absolute, non-fixed form and body. It pointed that the book, I Ching, studied the meaning of motion above. I Ching indicated “Yi” based on motion, change, and development to develop studies, which included the meanings of motion, change, and development of “sky and land”. I Ching firstly indicated clearly that “sky and land” and “motion” cannot be separated. “Yi” means motion, change, and development, and the “Yi” had developed studies the rules of “sky and land” based on motion, change, and development, which can be represented the rules of everything of motion, change, and development in the world. “Yi Li” included the rules of material motion, which is without deviation from the material motion. The motion of “sky and land” is absolute and it will not be confined to a specific “space-time”. The “sky and land” is infinite, eternal and is not belongs to a fixed space. The world is material, and the material world is eternal and changing (Mu, 2014), which is the same as the materialist dialectics theory among motion theory that “space and time existed with the material forms” (Zheng, 2013).

4.2.2.3. The study findings of infinity and limitations of “Time-space” in materialism of I Ching

One of the important principles of materialism dialecticals is the principles of infinity and limitations of “space-time”, I Ching materialistic also reflects this principle. The “sky and land” in the Book of Changes is an abstract concept of the sum of everything in the universe. The “sky and land” are the material rather than the concrete forms of material. *Xu Gua Zhuan* indicated that “there are sky and land, and then everything is born”. “When sky and land exists and then everything will be born, and then “men and women”, “fathers and sons”, “the uppers and the lowers” and “kings and minister” will be generated. This generated the word “etiquette”. Here we pointed the sky and land is a abstract three-dimensional space of material not a specific three-dimensional space of material. As the infiniteness of space-time is qualitatively speaking, the “time and space” is infinite among

the changing of form and level of material motion." (Mu, 2014) . I Ching mentioned that everything births after the sky and land had generated ,which is a specific form of material. Thus, the relationship of “men and women”, “fathers and sons”, “the uppers and the lowers” and “the kings and the minister” are all belongs to specific form of space and time and the specific form is infinite. Basically, the specific forms must include the birth and death , volume , and size, and the time and space acted as specific forms must be limited. "(Mu, 2014) It cannot be understood as "sky and land" is on Earth because people do not have the concept of the Earth in the era of the Book of Changes. Thus, the “sky and land” of the world is abstract called “space-time”, which is infinite. Abstract philosophical pointed that "sky and land" is the material not the concrete form of material .From the views of philosophy, “sky and land” is endless, non-destroyed, invisible and non-type. The specific features among running of the space and time is relative. When time and space regarded as the material forms of “sky and land” is constant, unconditional, and absolute. The specific forms and characteristics of time and space is variable, conditional, relative.

#### **4.2.3 The Study findings Materialism Conception of History of I Ching**

Materialism Conception of History thinks “Practice is under the guidance of the theory; the theory comes from the objective. The theory is the summary of the consciousness of the objection.” (Li, 2014). I Ching has many specific examples, such as gaining the true knowledge through passed time and changing the objective world through being under practice. *I Ching copulative* elaborated the activities of transforming and exploring the physical world. Understanding the complex phenomena of all things in the world by “divinatory symbols”( Gua ), mimicking the shape and appearance of all things, and reflecting their characteristics, which is called the “images of the trigrams”(Gua Xiang). The Saints used “images of the trigrams”(Gua Xiang) to indicate the motion of everything in the world, and to observe the universal changes of the motion, and to apply the rules and norms of “images of the trigrams” to assume that it is good or bad. This is called “Zhi”. See the examples given above, it described the tools, which is used to explore and transform in real-life. Here are the tools used by sages are the method of thinking, and it applied the method of induction in this paper.

#### **4.2.4 Summary the study findings**

The points has been made clear in the foregoing paragraphs, we can assume that the materialism of the I Ching is not a simple materialism but a distinctive feature of Chinese classical culture, which is materialism dialectical. The theoretical system of materialism of I Ching is comparatively complete materialism with the nature of the historical views of China's dialectical materialism and historical materialism. In this study, the author named I

Ching materialism as I Ching dialectical materialism and I Ching historical materialism. This is the basic content of the materialism of the I Ching.

## Chapter 5 Discussion and Conclusion

### 5.1 Summary of important findings in the study

In the process of studying of I Ching theories, the author argued the materialism of I Ching does not regard the concrete forms of one or several materials forms as the origin of the world. In order to understand the relationship of “Five Elements”, we also argued that the “Five Elements” is only a categorization method for expressing and distinguishing specific morphological attributes of different materials, which is an innovative research method. The purpose of studying the “Five Elements” is to research the mutual promotion and restraint between the Yin and Yang. *I Ching* never considered “Yin” and “Yang” nor “Dao” as the origin of the world. The “yin” and “yang” in the I Ching are opposite of the contradictions for everything, which were mentioned by all ancient philosophers, which is the unity of opposites, named “contradictions” that materialist dialectics refers to. The descriptions of above are highly consistent. The author concluded that “Tao” is “contradictions”. We concluded that the “Yu Zhou” is “sky and land” in I Ching. “Yu Zhou” is a general term for everything in the world, which was basically the same as “belongs to the highest abstract category of philosophy” of dialectical materialism. To sum up, the I Ching materialism does not have any features of simple materialism, we indicated that the materialism of the I Ching is not only an ancient simple materialism but also a simple materialism, and this conclusion has overturned the views that the academic areas have regarded the materialism in the I Ching as simple materialism. In this study, we stated the relationship between “sky and land” (Object), “Motion” and “Time-Space” of dialectical materialism. We also indicated the meaning of “three Yi” in I Ching, which including “not easy”, “change easy” and “simple.” By reasoning, the infinity and limitations of “space-time” in materialism of I Ching are also claimed by author in the study. Besides, we defined that “Yu” is the general term of space, “Zhou” is the general term of time “Yu Zhòu” means everything. Thus, we indicated “sky and land” is belonging to “material” of materialist dialectics. The author indicated that “Yu Zhou” is “sky and land” and “Yu Zhou” is everything, which belongs to the material of materialist dialectics. We revealed the relationship between “Yi” , “Yu Zhou” , “sky and land” and “space-time” and the relationship of “Motion” and “Yu Zhou” in materialist dialectics. The relationship between the limitlessness and limitedness of “space-time” in I Ching were also revealed in this study.

## **5.2 Conclude the new findings of the theoretical significance and practical significance of the study and application**

There are many problems have to be solved in I Ching study, for example, “what is Dao?”, “what is yin and yang?”, “what is sky and land?”, and even “what is easy?” And so on. . There is no clear definition of academia that it had created a huge obstacle to the study of classical Chinese philosophy, such as I Ching and Yi, and so on. In these years, for the I Ching studies in China has being still focused on the contents and thoughts of I Ching. Although there are essays on Dialectics and materialism in I Ching, and its contents cannot truly and effectively improve the level of the I Ching system studies. The author's findings in this article basically solved the several key questions of Yi Ching and Yi studies, which has been unable to clarify for many years. This will play a guiding role in in the I Ching and Yi studies in the future and will even become a milestone. The achievements of this research are innovative in the Marxist, we hope to effectively gave a suggestion to Chinese of applying Marxism to Chinese culture, which will play an key role in Chinese. At the same time, the study will effectively guide the process of sinicization of Marxism, and will indicated the ways how to solve the difficult problems of combining Marxism with Chinese traditional culture which will play an active role in the rejuvenation of the Chinese traditional culture.

## **5.3 An exhaustive study of findings that do not fit the Research hypothesis**

In this study, all results supported the study hypothesis. By reasoning, the important findings in the study include finding the success of “Dao” as contradictory and the successful positioning of “sky and land” as the discovery of “material”. The reasoning method was used to study by the author, the preconditions for reasoning were gradually obtained during the course of the research. Thus, there are lots of new findings in the paper, which is not a one-to-one correspondence to the presumption of pre-research but a basis of not changing too much research questions. This paper studies the elements one by one, and then through the method of reasoning, system logic analysis and other research methods to obtain refined research.

## **5.4 The research limitations that may affect the validity or generality of the results**

The theory obtained in this study included analytical methods, which were obtained through scientific text analysis and rigorous logical reasoning but also through rigorous testing, such as the introduction of the new vocabulary orientation into the specific theory of I Ching to analysis and to study whether the internal logic of I Ching has any unexplained situation. The authors have not been encountered in the study because it had no breakdown of the internal logical structure of I Ching by putting newly discovered knowledge into discussion.

On the other side, the new findings led the author to understanding I Ching. However, the research of historical materialism in I Ching is not in-depth in this paper due to the time limit, which has some limitations.

### 5.5 Conclude the suggestion of the future research.

In the future, the research should focus on epistemological questions of I Ching. At the same time, based on full understanding of historical materialism, we can make a systematic breakthrough in the historical materialism of I Ching.

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