ADDIS ABABA UNIVERSITY

SCHOOL OF GRADUATE STUDIES

COLLEGE OF NATURAL SCIENCES

CENTER FOR FOOD SCIENCE AND NUTRITION

EFFECT OF FIBER CONTENT AND RESPONSIVE FEEDING STYLE ON INTAKE OF INFANTS AGED 9-11 MONTHS IN WEST GOJAM, ETHIOPIA

BY: Mulubrhan Kahsay

A thesis submitted to the school of Graduate Studies of Addis Ababa University in partial fulfillment of the requirement for the Degree of Master of Science in Food Science and Nutrition.

Addis Ababa, Ethiopia

June, 2016

EFFECT OF FIBER CONTENT AND RESPONSIVE FEEDING STYLE ON INTAKE OF INFANTS AGED 9-11 MONTHS IN WEST GOJAM, ETHIOPIA

BY: **Mulubrhan Kahsay**

Advisor: **Kaleab Baye (PhD)**

Co-Advisor: **Clair Mouquet River (PhD)**

A thesis submitted to the school of Graduate Studies of Addis Ababa University in partial fulfillment of the requirement for the Degree of Master of Science in Food Science and Nutrition.

Approved by the Examining Board	Signature	Date
Examiner _____ (Internal)	_____	_____
Examiner _____ (External)	_____	_____
Advisor: **Kaleab Baye (PhD)**	_____	_____
Co-Advisor: **Clair Mouquet River (PhD)**	_____	_____

DECLARATION

I declare that this is my original work that all sources of materials used for the thesis have been duly acknowledged.

Signature: _____ Date: _____

The thesis has been approved for submission by:

Name of supervisors	Signature	Date
Kaleab Baye (PhD)	_____	_____
Claire Mouquet-Rivier (PhD)	_____	_____

Table of Contents

List of figures

List of tables

List of Abbreviations

AOAC	Association of Official Analytical Chemists
CSA	Central Statistical Agency
DF	Dietary Fiber
DHS	Demographic and Health Surveys
DOA	Department Of Agriculture
EFSA	European Food Safety Authority
ENA	Emergency Nutrition Assessment Software
EPHI	Ethiopian Public Health Institute
FAO	Food and Agriculture Organization
FGD	Focus Group Discussion
HB	Haemoglobin
HDL	Health Development Leader
HEW	Health Extension worker
IRD	Institute of Research for Development
IOM	Institute of Medicine
NFCS	National Food Consumption Survey
NNP	National Nutrition Program
PAHO	Pan American Health organization
RFT	Responsive Feeding Training
UNICEF	United Nations Children's Fund
WHO	World Health Organization

List of Equations

List of Annex

Acknowledgement

First and foremost, I would like to praise my God and Savoir. You have placed me on a path that I would never have imagined walking. Your goodness and blessings have truly followed me all the days of my life. My most sincere thanks goes to Dr. Kaleab Baye, my instructor and major advisor, whom I hold to the highest esteem, for initiating me to work on this project from scratch providing all the necessary support and encouragement as well as for the countless hours he dedicated towards my work, without his efforts all this would not have been possible. Dear Dr. Kaleab, thank you for always being there for me, for believing in me, for being my advisor and for your constant and relentless engagement in my work. I feel blessed to have been able to work with you and learn from you.

I would also like to warmly thank Dr. Claire Mouquet Rivier for taking the initiative to contribute to this document by providing important insights and for her exemplary dedication towards the project. I am very grateful for Nestle foundation granting the financial assistance needed to complete the study.

I would like to thank Enguti and Enamirt Kebele leaders for welcoming me and to all the caregivers who showed such enthusiasm throughout the project. A huge thank you to all of the data collectors, this project would not have been possible without you and I am truly grateful or all your hard work. I would also like to thank the amazingly prompt Bahr-Dar Health Office staff as well as Mecha wereda health officers, for facilitating the smooth undertaking of this study. Without your authorization and full cooperation, I wouldn't have been able to produce this piece of document. Finally, but certainly not least, my heartfelt thanks go to my dear Wife, family and to all friends and colleagues at the center for food science and nutrition, college of natural sciences.

ABSTRACT

Globally an estimated 162 million children less than five years of age are chronically undernourished. With 44% of children under the age of five years being stunted, 10% wasted, and 29% underweight, Ethiopia has one of the highest malnutrition rates in sub- Saharan Africa. Inadequate dietary intake due to compromised appetite along with poor quality complementary foods that are high in fiber and low in nutrient-density may be part of the problem.. Thus, the objective of this study is to investigate the effect of fiber content and responsive feeding style on the food intake of infants using a within subject cross over design.

Five key responsive feeding messages were formulated and their acceptance and feasibility of being adopted in the community was assessed using focus group discussion and in depth interviews. Complementary foods that are high and low in fiber were formulated. A trial among 36 mother–infant pairs (9-11 months) was investigated the food intake when high and low fiber complementary foods with and without responsive feeding were provided. The food intake of each infant was weighed daily using a kitchen scale.

Among the five responsive feeding messages, verbal encouragement and sensitization to appropriate portion size were the easiest to follow, whereas feeding with patience and self feeding encountered different reactions. The messages were accepted and can be easily adopted. However, intensive training and monitoring would be required. Intake of LF (87.66 g) was significantly higher than HF (86.18 g). After receiving responsive feeding training, infants' intake was increased by 12.15% and 27.83% for HF and LF, respectively.

Food intake decreases with increased fiber content. Responsive feeding significantly increases food intake, but the magnitude of the increase is dependent on fiber content. Applying responsive feeding and decorticating grains to decrease the fiber content is recommended to improve infants' food intake and prevent under-nutrition.

Key words: *malnutrition, fiber content, responsive feeding style and food intake*

CHAPTER ONE

1. INTRODUCTION

1.1 Background

Malnutrition is a complex phenomenon that stems from various underlying determinants, including a lack of optimal feeding practices for infants and young children (UNICEF, 2005). It is the largest risk factor in the world for disability and premature mortality among young children, especially in developing countries. Of the nearly 1.9 billion children in the developing world, 31% are stunted (UNICEF, 2005 & 2006). Despite the continued progress in all the developing countries, it is still predicted that there will be 128-155 million underweight children by the year 2020 with 35% of these children to be from sub-Saharan Africa (Underwood, 2002). In children, under-nutrition and micronutrient deficiencies are associated with poor growth, impaired cognitive development and poor health status (Black *et al*., 2008). The overwhelming impact of growth faltering is usually irreversible after the age of two, thereby leaving a small window of opportunity for intervention (Martorell *et al*., 1994). In this regard, the role of adequate complementary feeding, both in quantity and quality, is of great importance. Besides, not only what and when, but also how the child fed is crucial (Stewart *et al*., 2013).

In most developing countries, the amount of food consumed by infants and young children is lower than the theoretical gastric capacity making intake requirements even more difficult to meet (Baye *et al*., 2013 & Nguyen *et al*., 2010). This can partly be related to inappropriate feeding style (Moore *et al*. 2006) and thus promotion of responsive feeding practices together with appropriate nutrition education should be an important component of complementary feeding strategies **(**Aboud. *et al*., 2008). However, very few studies have evaluated the potential of responsive feeding on dietary intake (Hotz & Gibson, 2005 & Penny *et al*., 2005). Besides, complementary foods in rural parts of developing countries are usually prepared from high extraction rate flours (Gibson *et al.,* 2010). Such flours usually contain high amounts of fiber, which may have appetite suppressing effects

(Marciani *et al*.,2013). However, little is known as to whether infant's appetite improves with a decrease in the extraction rate of flours used to prepare complementary foods. Similarly, experimental studies investigating the role of responsive feeding on appetite are few and none have investigated how this can be affected by the fiber content of complementary foods.

1.2 Statement of the problem

In Ethiopia child malnutrition is of public health concern. With 44% of children under the age of five years being stunted, 10% wasted, and 29% underweight, the country has one of the highest malnutrition rates in sub- Saharan Africa (DHS, 2013). The few existing quantitative dietary intake surveys on children have indicated that energy and nutrient intakes were suboptimal (Gibson R.S *et al*., 2009 & Baye *et al*., 2013) and that mothers are concerned over the low appetite of their children (Baye *et al*., 2013). Whether this is associated to the high fiber contents of the complementary foods that are prepared from high extraction rate flours and, or to inappropriate feeding style remains unknown. Although inadequate food intake may partly be related to food insecurity, the high stunting rates in food surplus regions of Ethiopia (i.e Gojjam) suggest that inadequate feeding styles and complementary foods of low nutrient density may also play an important role and thus should not be ignored (Teshome *et al*., 2009). Only few studies exist on the feeding style behaviours of Ethiopian mothers (Aboud & Alemu, 1995 & Wondafrash *et al*., 2012) and the results are conflicting, suggesting that more studies are needed.

1.3 Objectives

1.3.1 General Objective

The overall objective of the study is to investigate the effect of feeding style and fiber content of complementary foods on food intake of infants (aged 9-11 months).

1.3.2 Specific objectives

-Formulate context specific responsive feeding messages and evaluate their cultural acceptability

-Investigate the effect of complementary foods from high and low extraction rate cereal flours on food intake of infants

-Investigate the effect of responsive feeding on the food intake of infants and evaluate the interaction of fiber content and responsive feeding

CHAPTER TWO

2. LITERATURE REVIEW

2.1Effect of feeding practice on appetite

Malnutrition is a complex phenomenon that stems from various underlying determinants, including a lack of optimal feeding practices for infants and young children (Engle & Lhotská, 1997 & Wondafrash *et al*, 2012). It is the largest risk factor in the world for disability and premature mortality among young children, especially in developing countries (Müller & Krawinkel, 2005; FAO/WHO, 1992**)**. i.e South Asia, sub-Saharan Africa and Latin America grapple with a similar problem of malnutrition, which has long term effects on physical and mental health. It is a common belief that poverty and a lack of available food and nutrients are the sole reason for malnutrition, however, "equally important are caring practices, such as infant and young children feeding, and the family resources needed to provide that care" (Engle & Lhotská, 1997). Infants and young children are at increased risk of malnutrition from six months of age onwards, when breast milk alone is no longer sufficient to meet all nutritional requirements and complementary feeding needs to be started (WHO, 2002). Although supplementary feeding may sometimes benefit children's length and weight gain (Sguassero *et al*, 2005**),** it is not feasible on a continuing basis in most developing countries.

Malnutrition is no longer considered simply to be a question of a shortage of good quality food (Engle *et al*., 1996**)**. Though higher incomes and better food security do improve nutrition over time, under-nutrition does not simply occur because of food insecurity or low income. Some children in low-income countries with high rates of malnutrition grow normally due to better education, household management, or coping skills of their mothers **(**Engle *et al*., 1996 & Pelto, 2000**).** According to Moore *et al*. (2006) and UNICEF, (2009) children's nutritional status was due not only to food availability and access to health care services, but also to difficulties in the interactions between caregivers and children.

Factors influencing low micronutrient intake because of dietary inadequacy could be inappropriate feeding and care in addition to constraints of availability or affordability at the household level (Penny *et al*, 2005). In UNICEF's conceptual framework for determinants of nutritional status, maternal and child care practices have been given due attention in addition to sufficient food supply at the household level, access to health services and a clean environment (Engle & Lhotská, 1997). Proper feeding practices, which ensure intake, are as important as the provision of complementary foods that meet nutritional requirements. According to WHO, (2002) recommendation, infants and young children need a caring adult or other responsible person who not only selects and offers appropriate foods but assists and encourages them to consume these foods in sufficient quantity. Improving complementary feeding requires attention to foods as well as to feeding behaviour of caregivers. As infants grow, they demand a food which is consistent and given with a child's signal of appetite and satiety, with appropriate meal frequency, feeding method and actively encouraging the child to consume sufficient food using fingers, spoon or self-feeding. As caregiver's behaviour has significant effect on infant's food intake, what seems the caregiver-child interaction should not be ignored.

The caregiver-child interaction (feeding style) critically influences dietary intake on top of the dietary aspect of child feeding (Ruel *et al*., 2003**)**. Appropriate child feeding practices and behaviours of parents have a positive effect on growth of infants and young children (Saha *et al*, 2008), however, it appears to vary among cultures, socioeconomic status and child's gender. Thus, the effect of different parental or caregiver feeding behaviours among various socio-cultural settings should be used cautiously (Wondafrash *et al*, 2012). Feeding styles were conceptualized and defined by Birch and Fisher (1995) as controlling, laissez-faire, and responsive feeding styles, and has been used in different researches (Ruel *et al*., 2003; Ha P.B *et al*., 2002 & Eshel *et al*., 2006). One important, yet relatively under-utilized, behavioural strategy involve responsive feeding. Although the concept, measurement and benefits of responsiveness in parent-child interaction are not new, its application to feeding is more recent (Engle & Zeitlin, 1996).

Maternal responsiveness describes a mother's ability to recognize and respond appropriately to her child's verbal and nonverbal cues including hunger and satiety cues. Responsiveness also requires a three-step process, whereby a mother observes the child, interprets the cue or state of the child, and then acts in accordance with the intended meaning of the cue (Pelto, 2000, Eshel *et al*., 2006, Bentley. *et al*, 2011, Engle *et al*, 2000 and Black & Aboud , 2011).

Responsive feeding practices are incorporating the components of care giving that are known to promote physical, mental, and social development more generally. Components of responsive feeding that are effective in increasing food intake include responding positively to the child with smiles, being sensitive and responsive to the child's signals, eye contact, and encouraging words; feeding the child slowly and patiently with good humor; waiting when the child stops eating and then offering more; and giving finger foods so the child can feed him/herself and staying with the child attentively through the mealtime (Engle *et al*., 2000 & Aboud *et al*., 2009**)**. A recent study in Bangladesh showed that weight gain and child self-feeding were significantly higher in the responsive feeding group than the control however; mouthful food eaten and maternal responsiveness were not significantly increased (Aboud *et al*, 2008**)**. One later, one of the published trials to isolate the effect of RF on child diet and growth was a cluster-randomized field trial in 37 villages (19 interventions and 18 controls) in rural Bangladesh. In both intervention and control villages, mothers of infants 8–20 month old received education on child development and child health and nutrition, which included advice on CF. Mothers in the intervention villages also received education on RF: 1) self-feed; let your child pick up food and eat; 2) be responsive; watch, listen, and respond in words to your child's signals; and 3) when your child refuses, pause and question why; do not force feed or threaten. Although the intervention significantly increased maternal verbal responsiveness during meals and child self-feeding, there were no differences between groups in either attained weight or WAZ **(**Aboud *et al*., 2009).

Likewise, in a study conducted in Vietnam caregivers who encourage their children to eat more has been positively associated with acceptance of food. However, food refusal and low appetite were commonly observed and were associated with low food intake when caregivers failed to encourage their children (Dearden *et al*, 2009). Moreover, a recent study in Burkina Faso revealed that training of mothers to encourage their young children during feeding is the best possible strategy to improve food intake, and hence to better satisfy the children's nutritional needs (Mouquet-Rivier *et al*., 2016).

Behavioural observations of mealtime with children aged 6–24 months in some countries have revealed low levels of responsive feeding, high levels of forceful or controlled feeding and either too much or too little self-feeding given the child's age (Ha P.B *et al*.,2002, Engle & Zeitlin, 1996; Moore. *et al*., 2006**)**. These behaviours are associated with fewer mouthfuls of food taken by the child and more refusals, despite the child's malnourished state. Consequently, mothers' feeding style is likely contributing to the poor appetite and nutritional status of young children in developing countries. On the other hand, positive caregiver behaviours were significantly associated with high child's acceptance of food so as children can able to have ideal growth standard and optimal nutrient intake (Ha P.B *et al*., 2002). Within a complementary feeding context, these practices call for a delicate balance between being responsive and active. For example, the mother will need to observe that her child can use the finger pincer motion to pick up solid food at 9 months, and respond to this ability by presenting food to be picked up. Likewise, the mother needs to respond to cues of satiety/ disinterest but also prevent anticipated refusals with active strategies. A report of PAHO, (2003) pointed out that children should be fed responsively and actively starting from the time of breastfeeding which mean that caregivers should able to read the signs of their children and act in accordance of it.

In a recent Bangladesh study, self-feeding was delayed beyond 24 months (Moore *et al*, 2006**)**, despite children's acquired psychomotor abilities to feed themselves partly by 9 months. Mothers also rarely responded to refusals by asking if the child wanted water, another food or a slower pace of feeding. Rather, they resorted to temporary diversions of the child's attention, promises, threats, following the child around the room, and sometimes forceful feeding. Although these strategies might lead to short-term compliance, they are

unlikely to help the child develop a healthy appetite, recognition of hunger and satiety cues and properly paced self-feeding.

2.2 Effect of Macronutrients on energy intake, satiety and satiation

Food consumption triggers a multitude of neural and hormonal signals, originating from the periphery and interacting with the central nervous system, that regulate food intake according to energy requirements. In response to the macronutrient composition in one's diet, the body releases hormones like gastrointestinal, pancreatic, and adipose-derived that ultimately signals the hypothalamus to contribute to the cessation of eating. This powerful feedback system is sensitive to the macronutrient composition of the diet and thus can easily be exploited to alter food intake (Bellissimo & Akhavan, 2015).

Appetite is the motive that leads a person to seek food, choose it and eat it (De Graaf *et al*., 2004). Appetite is often divided into three components; hunger, satiation, and satiety. Hunger describes the sensations that promote food consumption and is a multidimensional attribute with metabolic, sensory, and cognitive facets. Satiety is a state of suppression of appetite (the sensations that determine the inter meal period of fasting are termed satiety), while satiation moves into a deeper state of satiety. The mechanisms that regulate hunger, satiation, and satiety, and consequently food intake, have a physiological basis but may be strongly influenced by environmental factors (e. g. Health beliefs, habitual time).

Satiety and satiation are two important principles in the study of food intake control. Satiety is defined as the state of eating cessation, and it delays the initiation of subsequent meals. Satiation, on the other hand, is the process of feeling full during the course of eating, a form of intra-meal satiety that is assessed by measuring food intake. Satiety can be evaluated by perceived sensations, gastrointestinal hormonal responses, and eating initiation. Perceived satiety sensations, which are assessed by visual analog scales consisting of four questions on hunger, fullness, desire to eat, and prospective food consumption, are associated with the hormonal responses and predict both eating initiation and subsequent meal size (Blundell, 1996**).**

The impact of individual macronutrients on satiety is typically measured in experimental studies using a preload design. Participants consume preloads differing in energy density (the caloric content of a given weight of food) or in the amount of carbohydrate, protein, or fat, and their energy intakes at the same meal are observed. A food that is reported to have high satiety tends to produce a longer inter meal period (a period of time between eating episodes during which an individual does not experience hunger). Alternatively, foods that are reported to have lower satiety tend to produce a shorter inter meal period. Satiety and satiation are distinct but interrelated factors that influence both the type and amount of food consumed. Foods, and more specifically macronutrients, with the same caloric content exert different effects on satiation and satiety independent of their caloric value. In other words, not all calories are treated equally by the body **(**De Graaf *et al*., 2004).

Holt and colleagues calculated satiety index scores by dividing the area under the curve (AUC) for the satiety response to commonly consumed test foods by the study group mean satiety AUC for the satiety response to white bread, in this case, and multiplying by 100. They found that the sugar, starch, and total carbohydrate content of the foods were not statistically related to the satiety index scores; however, the direction of the relationship with starch was positive. Not all carbohydrates necessarily exert the same effect on inter meal and intra meal satiety (Holt. *et al*., 1995).

2.2.1 Effect of carbohydrate and fiber on food intake and satiety

Foods containing carbohydrates and dietary fiber make up a major component of a healthy, balanced diet. The categorization of compounds as carbohydrates is straightforward, as they are defined chemically, dependent on the presence of carbon, hydrogen and oxygen molecules in the correct ratios. However, there is much dispute over the components of dietary fiber, and there is not currently a single, worldwide definition for dietary fiber (Lunn & Buttriss, 2007).

Carbohydrates (CHO) provide a large percentage of our daily energy and are consumed in a wide variety of forms. Carbohydrates are the major food sources in the human diet. Depending on their digestibility characteristics, carbohydrates elicit distinct physiologic responses. Dietary fiber, sugars, and starches (including resistant starch) are the three major categories of carbohydrate. Sugars include monosaccharide, such as glucose, fructose, and galactose, and disaccharides, such as sucrose, maltose, and lactose. Dietary polysaccharides consist of oligosaccharides, such as maltodextrins and poly-dextrose; starches, such as amylose and amylopectin; and the non-starch category, such as cellulose and pectin (Cloetens *et al*., 2012 & IOM, 2001).

Dietary fibers, including soluble and insoluble, benefit human health through their effects on satiety, glycemia, gut microflora composition, and lipid profile. Dietary Fiber is defined as non digestible carbohydrates and lignin that are intrinsic and intact in plants. It fits the definition of functional food that can affect one or more targeted function in the body in positive manner. Higher fiber content of weaning food may inhibit mineral absorption and reduce the digestibility of protein in foods. Functional Fiber is defined as isolated, non digestible carbohydrates that have been shown to have beneficial physiological effects in humans (IOM, 2001). Total fiber is the sum of Dietary Fiber and Functional Fiber. There is much evidence that dietary fiber (DF) may contribute to present future health benefits in young children. For example, DF has a major influence on the bacterial colonization of the gastrointestinal tract and its maturation, in promoting laxation, and in establishing healthy eating patterns while eating foods high in DF is recognized as important, controversy over recommendations for infant DF intake exists (IOM, 2002).

The great concern about recommending a high-fiber diet for children is that it will decrease the energy density of the diet and cause problems for growth. Secondary to this factor is the concern that the fiber may trap micronutrients within the gut and therefore reduce bioavailability at a time when demands are high. In adults it has been well established that a high-fiber diet has very little impact on mineral balance, but there have been almost no studies in children. Viscous fibers delay the gastric emptying of ingested foods into the small intestine, which can result in a sensation of fullness. This delayed emptying effect also results in reduced postprandial blood glucose concentrations.

Increasing the intake of dietary fibers increases stool bulk, may cause flatulence and decrease appetite. Fiber has consistently been shown to have a higher satiety value when compared with digestible complex carbohydrates and simple sugar (IOM, 2001).

Foods that increase satiety and reduce food intake may be beneficial in controlling body weight however, in the developing countries foods with high fiber content may suppress appetite which leads under-nutrition. Complementary foods in rural parts of developing countries are usually prepared from high extraction rate flours (Gibson *et al*, 2010). Such flours usually contain high amounts of fiber which may have appetite suppressing effects (Marciani *et al*., 2013**)**. Studies revealed that the type as well as the amount of fiber consumed has different effect on food intake and appetite but the results are still inconsistent. There is evidence that β-glucan (from oats or barley), lupin kernel fiber, rye bran, whole grain rye, or a mixed high-fiber diet may decrease appetite more frequently than other fiber types (Tucker & Thomas, 2009; Clark & Slavin, 2013).

In epidemiologic studies, higher fiber and whole grain intakes are associated with lower body weights and the prevention of weight gain compared to diets low in fiber and whole grains. These effects may be due to enhanced satiety or decreased food intake after fiber consumption, with stomach distension, fermentation, and changes in gut hormones as possible mechanisms of appetite control (Clark & Slavin, 2013**)**.

2.2.2Effect of protein on food intake and satiety

Most research has suggested that the macronutrient protein has the most potent action on satiety. Hydrated foods that were high in protein, fiber, or water content had higher satiety index scores. Many studies have investigated the effects of protein on satiety, and most but not all have found that, at sufficiently high levels, protein has a stronger effect on satiety than equivalent quantities of energy from carbohydrate or fat. Most studies investigating the effects of protein on satiety have followed a preload design, where the protein content of the preload is varied and the effects on subsequent self-reported ratings of appetite and/or energy intake are measured (Benelam , 2009**).**

A review of studies on protein, satiety and weight loss by Halton and Hu, (2004) looked at both short term and longer-term studies on satiety, energy intake and bodyweight change. Out of 14 short-term studies, 11 found that the higher protein preload significantly increased ratings of satiety and 8 out of 15 studies found that the subsequent energy intake was significantly lower in the higher protein condition than in the control. The test period in the different studies ranged from 1 to 24 hours, and the proportions of macronutrients in the test and control preloads also varied with 29% to 100% protein in the high protein test and a variety of higher carbohydrate or fat preloads for the control. The form of the preload also varied, from mixed meals to single drinks (Halton & Hu 2004**.**

Some studies have investigated the short-term effects of different protein sources on satiety. Uhe *et al*. (1992) measured the relative satiating effects of protein in beef, chicken and fish over a period of three hours. VAS measures of satiety were found to be significantly higher after subjects consumed fish than beef or chicken (Uhe *et al*. (1992**)**. Subsequent energy intake was not measured. Similarly, Borzoei *et al*. (2006) also looked at the satiating effects of beef and fish and found a non-significant increase in satiety and a significant decrease in energy intake at a subsequent meal after the fish compared with the beef.

2.2.3 Effect of fat on food intake and satiety

Fat is a major source of fuel energy for the body and aids in the absorption of fat-soluble vitamins and other food components such as carotenoids. Dietary fats provide the infant and young child with energy, essential fatty acids and the fat soluble vitamins A, D, E and K. Fat not only provides energy in the diet, but also has an important role for promoting good health in humans. Fat accounts for approximately 50% of the energy in breast-milk and is the main source of energy for infants less than 6 months old (EFSA, 2010).

Dietary fat affects satiation and satiety by slowing gastric emptying, stimulating the release of satiating gut hormones and suppressing the release of ghrelin (Little *et al*., 2007**)**. However, it has been suggested that the effect of fat on satiety is weaker than that of either protein or carbohydrate (Rolls *et al*., 1998, & Westerterp, 2004**).** With the introduction of complementary food, fat is gradually overtaken by carbohydrate as the chief energy source, and together they meet the energy needs of the growing child. The amount of energy obtained from fats in the diet of infants under 2 years is arguable. Most authors state that fatty energy probably covers between 30% and 45% of total energy intake in infants less than 2 years (Butte, 2000).

It is found that fats and carbohydrates do not have identical effects on the appetite profile. Their studies, in agreement with those of others, showed that high fat foods have a weak effect on satiation and satiety compared with sucrose. More energy-dense (calorie/g), fat-rich foods had lower satiety index scores. The fact that high-fat foods are more energy dense, have a higher palatability, and have lower intra-meal and inter-meal satiety value helps explain why individuals tend to over consume high-fat foods, a process termed passive over-consumption (Koletzko *et al*., 2009).

Blundell *et al*. (1993) investigated the effects on subsequent energy intake of the addition of either a carbohydrate or fat supplement of 1.52 MJ (362 kcal) to a standard breakfast in lean male subjects, 90 and 270 minutes after eating the breakfast. The carbohydrate supplement resulted in a reduction in energy intake after 90 minutes but not after 270 minutes, but the fat supplement produced no reduction in subsequent energy intake. Although the fat and carbohydrate supplements were matched for energy content, the higher energy content per gram of fat than of carbohydrate results in a higher energy density (kJ/g; kcal/g) in the fat supplement. So it is not possible to discern whether the results in this study were due to the specific effects of fat on satiety or differences in energy density.

Stubbs (1996) looked at the effects of breakfasts high in protein (HP), carbohydrate (HC) or fat (HF) on appetite ratings and energy intake at a test lunch, five hours later and for the rest of the day (until 11 pm). The breakfasts were matched for energy density and palatability. They found that hunger was highest after the HF breakfast compared with the HP and HC breakfasts, and that the HP breakfast was the most effective at suppressing hunger throughout the day. However, these differences did not translate into significant differences in energy intake either at the lunch or during the rest of the study day. Another study that compared the effects of meals containing varying amounts of fat, matched at two different levels of energy density. This created six different experimental conditions: lower-energy density with a low-, medium- or high-fat content or higher-energy density with a low-, medium- or high-fat content. Thirty-six subjects attended the laboratory on six occasions (to test each experimental condition) and ate breakfast, lunch, dinner and an evening snack. Ratings of appetite and daily energy intakes were measured. No significant differences were seen in appetite ratings, but energy intakes were significantly higher (by 20%) on the higher-energy density than on the lower-energy density diets. When energy density was matched, the fat content of the diets did not affect energy intake, indicating that it was the energy density and not the fat content that influenced satiety (Bell & Rolls, 2001).

2.3 Effect of energy density on energy intake and satiety

Energy density is the amount of energy in a given weight of food or drink (kJ/g, kcal/g). A number of studies have shown that, when subjects are allowed free access to a range of foods, they will consistently consume a similar weight of food each day, rather than a constant amount of energy (Rolls, 2000**)**. This means that the lower the energy content of the foods eaten (i.e. the less energy dense they are), the lower overall energy intake will be and vice versa.

The primary determinants of energy density are water and fat, and foods with the lowest energy density are those with the most water and least fat. Conversely, high-energy dense foods are typically high in fat and low in water. Fiber can also help reduce energy density (Drewnowski, 1998**)**. It is important to note that energy density tends to be proportional to palatability, which itself affects satiety, and therefore it is important for studies investigating the effects of energy density to control for palatability.

Investigating the effects of energy density on satiation (i.e. how much energy is consumed in one sitting), tested the quantity of foods with high-, medium- or low-energy density that female subjects consumed over two days, using a crossover design, so that subjects tried all three dishes on separate occasions. The dishes were matched for fat content and palatability, and energy density was reduced by adding vegetables. The subjects ate a similar weight of the meal in each case, which resulted in a 30% reduction in energy intake from the meal with the low- vs. high-energy density, without any differences in ratings of hunger or fullness (Bell *et al*., 1998**)**. This study showed that higher-energy density foods were less satiating, but did not provide further information about satiety or subsequent energy intake.

Leahy *et al*. (2008) looked at the effect of reducing the energy density of a dish served at lunch on energy intake in children aged between 2 and 5 years. Higher and lower-energy density versions were served along with other side dishes, and children were allowed to eat ad libitum. The lower-energy density version led to a decrease in energy intake from both the dish itself and the lunch overall.

A year-long trial compared two weight-loss diets, one where subjects were counselled to reduce fat intake (RF) and the other where they were counselled to reduce fat and to increase consumption of water-rich foods, particularly fruits and vegetables (RF + FV), reducing the energy density of the diet to a greater extent. Both groups were told to eat adlibitum within these recommendations. Both groups reduced their fat intake to a similar extent, but those on the RF+FV diet had a lower energy density, consumed a larger weight of food and reported being less hungry than the RF group. Both groups lost weight, but the RF+FV group lost significantly more that the RF group (Ello-Martin *et al*. (2007).

A six-month intervention trial tested the effects of different levels of dietary advice, resulting in a reduction in energy density of the diet and weight loss. When subjects were categorized according to the reduction in energy density resulting from the intervention, it was found that both modest and large reductions in energy density were associated with weight loss (Ledikwe *et al*. (2007).

CHAPTER THREE

3. MATERIALS AND METHODS

3.1 Study site

The study was conducted in Mecha district, West Gojjam, Amhara regional state, Ethiopia. It is located at 524 km north-west of Addis Ababa, 34 km South East of BahirDar, the capital city of Amhara regional state. It is situated at an altitude ranging from 1500-1800 meters above sea level (DOA, 2000). The woreda has a total population of 292,080 and 7.7 % of the total population are urban inhabitants (DHS, 2013). West Gojjam zone is one of the food secure region in Ethiopia, but the region has highest prevalence of stunting (Teshome *et al*., 2009). This suggests that inadequate complementary feeding and inappropriate feeding practice rather than food insecurity may be the problem. Therefore, locating the study in this site allowed to discriminately evaluate the effects of responsive feeding and fiber content on food intake of infants.

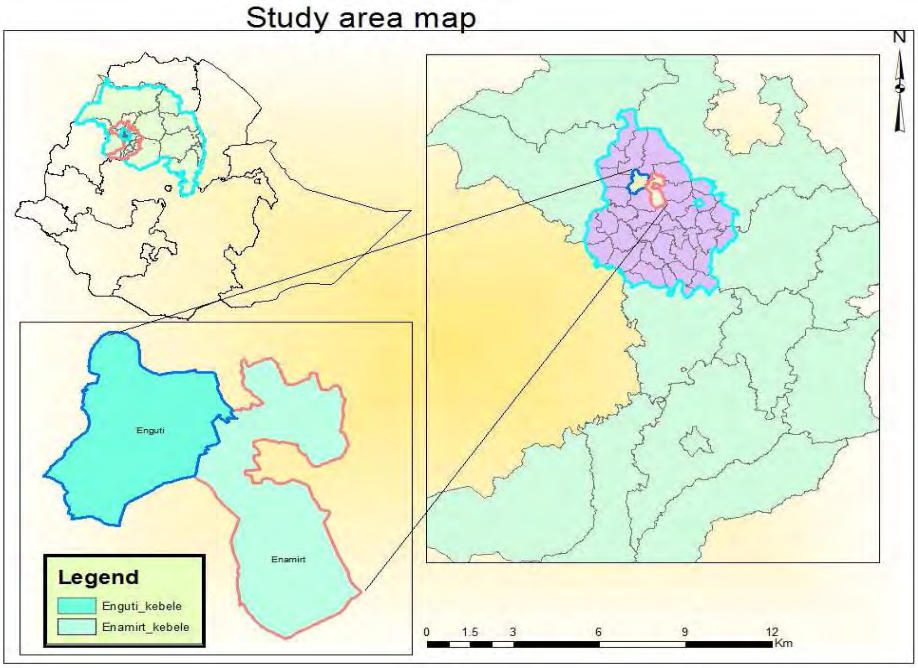


Fig.1 Map of the study area

3.2 Ethical approval

Ethical approval was obtained from College of Natural Sciences Research Ethics Review Committee of Addis Ababa University and the Institute of Research for Development (IRD), France.

Legal guardians of each child participating in the study received verbal explanations about why and how the study is to be conducted. Risks and benefits were explained to them. Each child had the right to withdraw from the study at any time without further consequences. Infants were treated respectfully in a friendly manner. Legal guardians have signed the informed consent. In case of illiteracy, signing was done with fingerprint. The consent forms as well as all questionnaires were translated in the local language, Amharic. The health extension workers of the health center and local authorities were informed of the study and its objectives before it started.

3.2 Participants

Breast-fed children between 9-11 months of age were recruited before the study. For this, a sampling frame was constituted based on the database records of the health centers of the study site. Convenient sampling was performed to select two rural kebeles of the study area from where study participants, aged 9-11 months, were recruited. The 9-11 month age range was selected because: 1) stunting rate starts to peak in this period (Good S. *et al* 2009); 2) by this age, most if not all of the infants are introduced to CFs; 3) the child's inability to talk makes responsive feeding behaviours of caregivers even more important than for older children (12-23 months); 4) energy intakes are often below the recommendations.

3.2.1 Eligibility of subjects

Inclusion criteria

Infants who participated in this study were in the age range of 9-11months, not anaemic and have started cereal based porridges. Besides, the caregivers should accept that intake of their child is weighed.

Exclusion criteria

Infants affected by severe malnutrition with length-for-age (LAZ), weight-for-age (WAZ) or weight-for-height (WHZ) z-scores <-3 based on WHO growth standards (Onis M, WHO, 2006). These infants were referred to the closest health center for follow up.

Informed consent was obtained from each infant, whenever possible from both parents/caregivers. An information sheet describing the study and its objectives was also left to the parents/caregivers.

3.3. Sample size estimation

The sample size calculation for the responsive feeding trial was based on a previous study conducted in Ouagadougou (Mouquet-Rivier *et al.*, 2016) which is calculated by G-power software. Assuming a within subject variation of 46%, a sample size of 29 would allow us to detect 20% difference in mean intakes ($\alpha = 0.05$ and $\beta = 20\%$). To allow dropouts of up to 20% the sample size was increased to 36 infants.

3.4. Anthropometric measurements

Anthropometric were taken using standardized techniques with the children wearing no shoes and light clothes. All anthropometric measurements were made by the same person. Z-scores for length-for-age (LAZ), weight-for-age (WAZ) and weight-for-height (WHZ) were calculated using ENA software (2007), based on WHO multicenter growth reference data (Onis M, WHO, 2006).

3.5 Haemoglobin screening

Haemoglobin was assessed using Haemocue HB 301 system. This system consists of battery operated photometer and disposable microcuvette, coated with a dried reagent that serves as the blood collection device. The test is performed using a drop of blood taken from the infant's fingertip.

After wearing glove for protection, the infants' middle or ring finger was cleansed with a disinfectant wipe and the side of it was pricked by using a lancet. After wiping away the first 2-3 drops of blood, light pressure was re-applied towards the fingertip and a drop of blood was collected directly into the testing cuvette and was filled in one continuous process but not overfilled.

The filled cuvette was placed into the cuvette holder immediately, lot number was given to the cuvettes, and haemoglobin reading was recorded on the chart. The cuvette and the lancet were discarded in the appropriate waste container and the instrument was cleaned with alcohol in between each measurement (Tariku A, 2016).

3.6. Preparation and Formulation of complementary foods with high and low fiber content

The most frequently consumed cereals were identified as maize and pea in an earlier study that used meal observations (Tariku A. 2016). These grains were used for the formulation of the high and low fiber complementary foods.

3.6.1 Formulation of complementary food with high and low fiber content

The complementary food formulations were calculated with ALICOM software to meet the current recommendations for most macro and micronutrient contents in fortified complementary foods (Lutter & Dewey, 2003). The complementary food formulations were based on locally available cereal and legume blends, with addition of oil, sugar and vitamin-mineral premix in adequate proportions. The macronutrient contents of the blended flours were analyzed. As the maize and pea had high water absorption it was seen that the porridge was strongly thickened after few minutes of preparation. 0.002% of

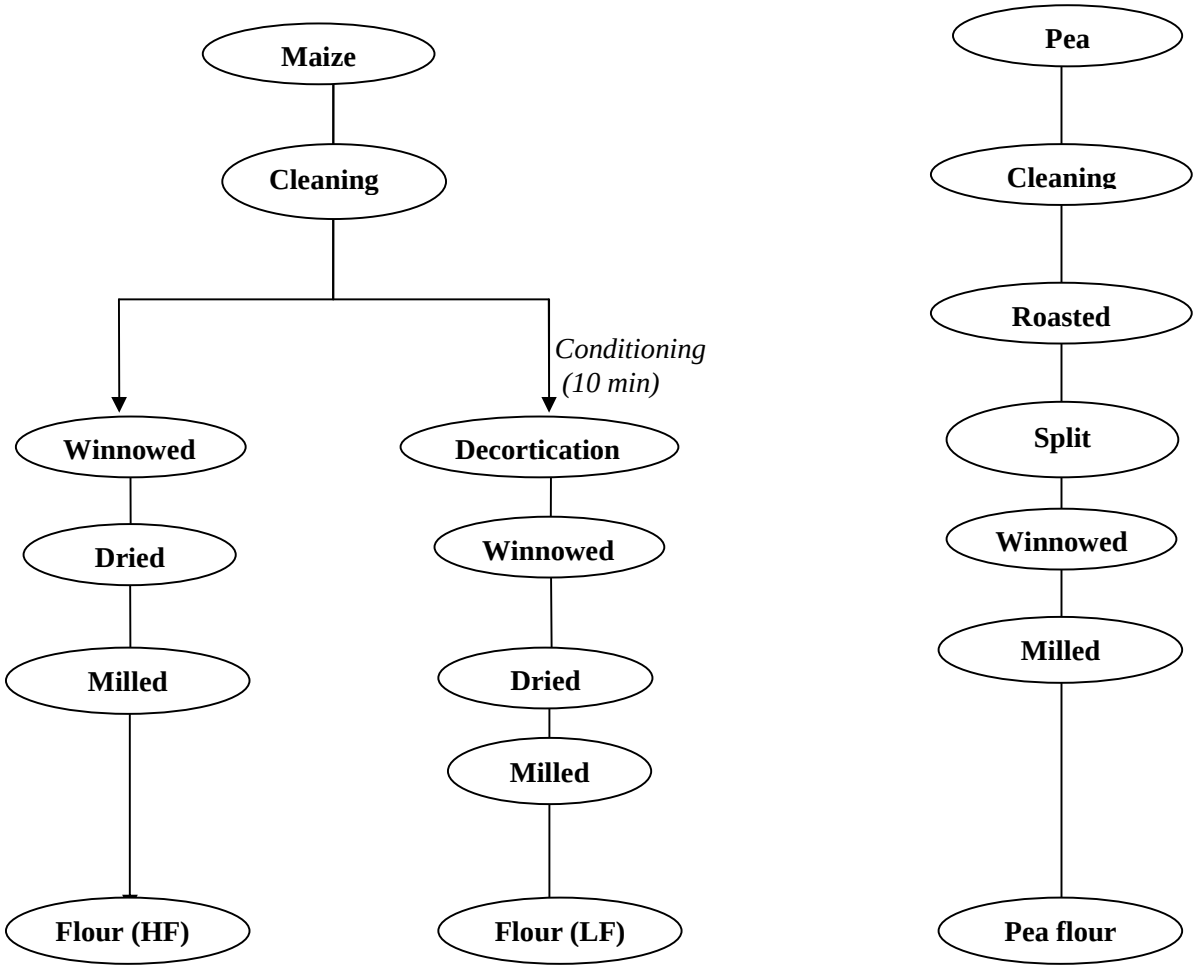
alpha-amylase enzyme (Novozymes, BAN 800) was added to both blends to liquefy and improve the consistency as well as the energy density of the porridge.

Table 3.1. Formulation of complementary food with high and low fiber content (Sara, 2016)

Ingredient	High Fiber (wet basis %)	Low Fiber (wet basis %)
Maize (Whole)	45.81	-
Decorticated Maize	-	45.32
Husk	2	-
Roasted and split field pea	27.79	27.81
Milk powder	11.52	11.53
Sugar	9.09	9.10
Palm oil	3.06	3.52
Soy oil	1.68	1.68
Iodized salt	0.56	0.56
Premix-Nutrifaso	0.27	0.27
$CaCO_3$	0.21	0.21
Amylase	0.002	0.002

3.6.2 Flour preparation

Forty kg of maize and thirty kg of pea were purchased from Merkato, Addis Ababa. Both the maize grains and peas were sorted out to clean and separate unwanted materials. Peas were lightly roasted (not more than two minute). Maize grains (15 kg) were decorticated using wooden mortar and pestle by two women, who had the traditional skills of processing maize. The decortication lasted until the flour reached 75% extraction rate, at Food science and nutrition laboratory, Addis Ababa University, Ethiopia. Three litre of water was added to each 2 kg of maize grain for the initial conditioning to facilitate decortications. Then the decorticated maize was dried and moisture content was analyzed. The remaining15 kg of maize was used to prepare high fiber flour, which was prepared from undecorticated maize with the addition of 2% maize husk.



HF: high fiber LF: low fiber

Fig.2. Preparation of high fiber and low fiber flour

3.7 Proximate analysis of the complementary food

The proximate analysis of the complementary food was analyzed using the AOAC (2000) method.

3.7.1. Moisture analysis

The moisture content of CF was determined by hot air drying method according to the official method of 925.09 of AOAC (2000). Steel crucibles were properly cleaned and dried in drying oven at 105^0C for 1 hour. The crucibles were taken out from the oven, cooled in a desiccator for 30 minute and then their weight measured (W_1). Five gram of CF flours were weighed in each crucible and dried in drying oven at 105^0C for 3 hours. After that the weight of the crucible containing the sample was measured (W_2). After drying, the crucibles containing the dried sample were cooled in a desiccator at room temperature and weighing of the sample was continued until a constant weight is obtained (W_3). The last constant measurement was taken to calculate the moisture content of CF using the following formula:-

$$\textbf{Moisture \%} = \frac{W2-W3}{W2-W1} \textbf{x100....(1)}$$

Where, W_1= Weight if the crucible, W_2 = Weight of the sample and the crucible before drying, W_3 = Weight of the crucible and the sample after drying.

3.7.2. Crude protein

The analysis of protein content was determined by the micro kjeldahl method according to the official method 979.09 of the AOAC (2000). The complete analysis of protein involves the following three steps:-

0.5g of each CF flours was weighed in a clean tecator tube and placed in tecator rack. 6ml of concentrated sulfuric acid was added in to the tubes containing the sample for dejection facilitation purpose using a pipette and then mixed carefully. 3.5ml of Hydrogen peroxide was added in a step wise manner to each sample tube. Here as soon as the most violate reaction has ceased, the tube was shacked for few minutes by hand and put it back in to

the rack. 3 g catalytic mixture of copper sulfate and potassium sulfate was added in to the sample tubes and the tubes were let to stand for 15 minutes before digestion.

A. Digestion- The sample tubes were placed in a digester after the working temperature has reached at 370°C and the digestion process has continued until clear solution was observed. The sample tubes were taken out, placed in the rack and allowed to cool in fume hood. Later on, 50ml of distilled water was added into the sample tubes in order to avoid precipitation of sulfate.

B. Distillation- At this step25ml of 35% NaOH was added to neutralize sulfuric acid and this enables for the release of ammonia. A 250ml Erlenmeyer flask containing 25 ml of 4 % H_3BO_3, 25 ml of distilled water and 3 drops of methyl red indicator solution was placed as receiver on the distillation unit. The distillation process was continued until the volume of the distillate reached between 200ml and 250ml.

C. Titration-the distillate was finally titrated with standardized 0.1N of HCI until the appearance of the first pink color. At this point the amount of consumed HCI was immediately recorded. Furthermore the blank reagent was run to subtract the reagent Nitrogen from the sample Nitrogen. The amount of protein was calculated by using the following formula:-

$$\textbf{Crude protein \%} = \frac{(V2-V1)\ X\ N\ X\ 14.01\ X\ 6.25}{10\ X\ W} \quad \textbf{..... (2)}$$

Where, V1 = Volume (ml) of HCI solution required for the blank test.

V2 = Volume (ml) of HCI solution required for the test sample.

N = Normality of HCI

W= weight of sample

3.7.3. Crude fat

At the beginning , an extraction cylinder was washed with hot water to remove any impurity and put it in to an oven for about 1 hour at a temperature of 105°C.Then after, taken out them and put in to a desiccator , after cooling weighed (W1) and turn out them again in to the desiccators. The bottom of the extraction thimbles was covered with a layer of fat free cotton. The crude fat was actually extracted using Soxhlet apparatus according

to AOAC (2000) official method 45.01. About 2g of each CF flours was measured in the thimbles and was covered with a layer of fat free cotton (W). The thimbles were put in the extraction chamber and extraction cylinders were taken out of the desiccator and put on the bracket. 50ml of petroleum ether with boiling point range between 40-60^{0}C was added into the cylinders and the thimble was immersed in the cylinder containing petroleum ether and digested at 55^{0}Cfor 2 hours. Fat extraction was continued for additional 2 hours while the temperature was set at 60 ^{0}C .Once the extraction process completed, the cylinders containing extracted fat were disconnected and were put in a drying oven at 70 ^{0}C for about 30 minutes. The cylinders were taken out of the oven, cooled in a desiccator for 30 minutes and weighed (W_2) immediately after they taken out of the desiccator. The amount of extractable fat was calculated using the following formula:-

$$\textbf{Crude fat \%} = \left\{ \frac{W2-W1}{W} \right\} \textbf{ x100 …… (3)}$$

Where, W1= Weight of extraction cylinder

W2 = Weight of the extraction cylinder plus the dried crud fat

W = Weight of sample

3.7.4. Crude fiber

Crude fiber content of CF flour samples was determined according to the official method of 979.09 of AOAC (2000). The following steps were used during for the complete analysis of the sample:-

Step 1. Extraction: 1 g of sample was weighed and placed in a 600 ml beaker. After adding 200ml of 1.25 % H_2So4 and boiling for 30 minute the watch glass was placed over the beaker. It was then gently heated on a hot plate and keeping the level constant with distilled water. 30 minutes later, 20 ml of 28% KOH was added and boil gently for further 30 minutes and stir wisely.

Step 2.Filtration: The bottom of a sintered glass crucible was covered with 10 mm sand and the layer of sand was with a little distilled water. Solution from beaker poured into sintered glass crucible and turns on vacuum pump. Beaker walls were rinsed with hot,

distilled water several times, washings were transferring to crucible and then filtered residue was washed in crucible with hot distilled water and filtered. After wards, repeated the step once again. The residue was continuously washed with 1% H_2SO_4, hot distilled water, 1%NaOH, hot, distilled water, 1 % H_2SO_4 and Washed twice more with hot distilled water and it was filtered in each washed intervals consecutively.

Step 3. Drying and Combustion: in this step crucible was dried for 2 hours in the electric oven at 130^{o}c and Cooled for 30 minutes in a desiccator and then weighed (W1). Crucible was Transfer to muffle furnace and stay for 30 minute at 550 -600^{o}C, Cooled in a desiccator and weighed (W2).the crude fiber of the sample was finally calculated according to the following formula:

$$\textbf{Crude fiber in \%} = \frac{(W1-W2)\ x100}{W3} \ldots\ldots\ldots \textbf{(4)}$$

Where, W1 = Crucible weight before drying

W_2 = Crucible weight after drying

W_3 = Sample dry weight

3.7.5. Total ash content

The ash content of the blended flour was determined according to the official method of 923.03of the AOAC (2000). Porcelain crucibles were cleaned and dried in muffle furnace for 30 minutes at 550 °C. After the crucible cooled in a desiccator for 30 minutes at room temperature; they were weighed (W_1) using analytical balance. About 2.5 g of CF flour sample was weighed in each cleaned crucibles (W2). Next, the samples were charred on a hot plate under a fume hood until the smoke ceased down. The charred sample was incinerated in a muffle furnace at 550 °C for 5 hours till the residue becomes white in color after that they were cooled in a desiccator and their weigh was recorded (M_3). The amount of total ash presented in the samples was calculated using the following formula:-

$$\textbf{Ash \%} = \frac{W3-W1}{W2-W1}\ \textbf{x100}\ldots\ldots\textbf{(5)}$$

3.7.6. Total carbohydrate content

Total carbohydrate content of the flour samples was determined by the difference method (i.e.by subtracting the sum of percentage of moisture, crude protein, crude fat, crude fiber and ash content from 100%).

Total carbohydrates (%) = 100- (% moisture + % Protein + % of fat + % ash)…. (6)

3.7.7 Energy values

Gross energy was determined by calculating the energy from fat, carbohydrate, fiber and protein contents using the Atwater's conversion factors. In recent years, an energy factor for dietary fiber is 8.0KJ/g (2.0kcal/g). Several studies show that part of dietary fiber is fermented in the colon by microorganisms and that the produced short chain fatty acids are absorbed. It is estimated that the metabolizable energy (ME) from this short chain fatty acids provide on average 8 KJ/g (2 Kcal/g) dietary fiber (**FAO, 2003**).

Total energy (Kcal/100g) = [(% available carbohydrate x 4) + (% protein x 4) + (% fat x 9) + (%fiber x 2)]……. (7)

3.8 Formulations of culturally-adapted responsive feeding messages

Culturally-adapted responsive feeding messages were developed based on the analyses of video-taped meal observations among 106 infants (aged 9-11 months) conducted in an earlier study in Mecha district (Tariku A., 2016). The acceptability and feasibility of the developed messages by mothers and health extension workers was then tested. The developed messages were the following:

-Message 1: Eye to eye contact -face to face position, verbal encouragement
-Message 2: Sensitization to appropriate portion size
-Message 3: Feed patiently but with regular rhythm.
-Message 4: Avoid too much distraction during feeding,
-Message 5: Allow the child to self-feed by giving him a second spoon

3.9 Acceptability and feasibility of formulated responsive feeding messages

After selection of culturally adapted messages, focus group discussion with mothers and key informants were conducted.

3.9.1 Focus group discussions with mothers

Focus group discussions were chosen as the method for this study, because they are suitable for exploring cultural and community opinions (USAID, 2011, Den Hartog *et al*., 2006, and Krueger & Casey, 2000). According to literature, at least two discussions and group size of 6-12 people are needed for each study segment to obtain sufficient data (Krueger & Casey, 2000 and Hennink (2007). Group discussion participants are usually recruited so that they have similar characteristics or share a mutual experience on the research topic (Hennink (2007). In this study women with a 9-11-month-old child were contacted to test the acceptance of the selected responsive feeding messages. A total of two focus group discussions (FGDs) were organized with the caregivers. Both FGDs were organized at the village center and eight caregivers were joined. The village was thirty minutes' walk from Merawi city, capital of Mecha district. The discussion lasted for about 45 minutes. One week later another focal group discussion has been conducted with eight

caregivers with a 9 to 11 month old child, two participants didn't finish the discussion. A total of fourteen caregivers attended the focus group discussion. Both discussions were moderated and guided by a discussion guide (Annex I) Information gathered from the focused-group discussion was triangulated with those obtained from in-depth interviews.

Table 3.2.Number of participants in the FGDs and Interviews

	Individual Interview	FGD
Caregivers	8	8 & 6
HEW	4	8
HDL	4	5
Total	16	27

FGD: Focus group discussion HEW: Health extension worker HDL: Health development leader

3.9.2 Focus group discussions with key informants (HEWs and HDLs)

Two separate focus group discussions were organized to have the perspective of the HEWs and HDLs. The discussions had two objectives: the first was to have the perspective of the HEWs and the HDLs on the acceptability and applicability of the developed responsive feeding messages. The second was to have a programmatic/ implementation perspective on the feasibility of integrating the messages as part of the health extension workers routine nutrition education program. The discussion with HEWs (n=8) was held at the Mecha district health bureau while the discussion with and HDLs' (n= 5) was held at the village meeting room (Table 3.2).

Feasibility scoring

A feasibility scoring system was developed and the messages were ranked for their feasibility using the following ranking as perceived by the key informants:

-Ease of applying the message

-Compatibility with the mothers beliefs and culture

-Compatibility with the current feeding practice of the mothers

-Acceptability of the time and efforts required to apply the message

A score of 1 (acceptable) or 0 (not acceptable) was given for each criteria and for each message, and was summed to provide an overall acceptability score. Both discussions were led by a moderator and were instructed by a discussion guide (Annex II). The information gathered through the FGDs was further triangulated through information obtained by subsequent independent interviews with the focused group discussants.

3.10. Triangulation

Triangulation is a useful method that provides multiple perspectives, and increases the validity and strength of the research, while decreasing bias (Thurmond 2001). Methodological triangulation is a way of combining or comparing data collected with different research methodologies (Thurmond 2001). It offers a great opportunity to reveal meaningful information that might have been left undiscovered if only a single data collection technique was used. Methodological triangulation has been used to compare the data collected from focus group discussions and from interviews. It is possible that the answers in these two situations are different. For example, in interviews participants may be able to speak more freely about sensitive issues than in group discussions. Data triangulation means using data collected in a different time or environment or from different informants (Thurmond 2001).In this study methodological triangulation has been used. The opinions and attitudes of mothers and key informants obtained via FGD have been compared to the data collected via interviews.

3.11 Preparation of standard porridge and Training of data collectors on how to prepare porridge using standardized procedure

Differences in food characteristics may significantly affect the food intake and appetite of infants. To better isolate the effect of feeding style, fiber content and better control for confounders such as food characteristics, energy density and macronutrient composition, standard complementary foods with the same macronutrient composition except fiber and the same energy density were prepared (Table 4.1). Similarly, the viscosity (83s-1, 45°C) and consistency (mm/30sec) of the porridge was in range: 1-3 Pa.s and 153 mm/30sec respectively which is suitable for infant and young children. Prior to the actual trial, demonstration on the preparation of standardized porridges with appropriate

consistency and texture that is thick enough to stay on a spoon and 25% of dry matter content was demonstrated. Ten Data collectors who have completed grade ten and able to communicate with mothers were recruited. The data collectors were intensively trained for seven consecutive days on how to prepare porridge using standardized procedure. Special emphasis was given to transfer messages of hygienic practices and demonstrate adequate consistency of complementary foods. The same kitchen utensils like kitchen scale (precision of 1g), pan with its cover, spoon, bowl, beaker and sachets were purchased from the market and were provided to the data collectors to minimize errors during weighing. All the utensils used for this purpose were washed and cleaned daily then the weight of the pan with its cover and spoon was first weighed and recorded. Then after, a constant amount, 54 gram of flour and 196 gram of water was added and stirred until it completely mixed. After cooking for 5 minutes, the porridge was checked till 50 gram of water was evaporated. The porridge was then cooled for three minutes and immediately transferred to the bowl, and was ready to be consumed by the infant. The constant amount of water and flour was determined to meet the appropriate amount of porridge that can be given to infants in the age range of 9-11 month which should be not lower than 200 g per day (PAHO/WHO, 2003).

3.12. Fiber and responsive feeding trial

Before the feeding trial, there were four days of adaptation period to the high (HF) and low fiber (LF) complementary foods. A supply enough for four days (60-80 g of each CF) were provided to the caregivers so that they serve their infants each formulation (high/low fiber) for at least twice a day.

For the feeding trail, each day, trained data collectors carried a sachet of the formulated CF flour to prepare the CFs in the households following a standardized procedure. A clean cloth was also provided to data collectors to clean up child's hand, face, mouth and porridge droppings during feeding. The effect of fiber content on the infants' intake per meal was evaluated in-home using a within subject cross over design. Food intake was evaluated by recording intake of the test meal (satiation). Intakes were measured by subtracting the left over from the initial weight of the complementary food using a kitchen

scale equipped with a high precision strain gauge sensor system (Electronic kitchen scale, SF, 400).

Food intake = ((weight of bowl+spoon+porridge before consumption – bowl+spoon+porridge after consumption) –(weight of cloth after- weight of cloth before))……..(8)

The study had two phases. In the first phase infants were given the porridge without responsive feeding and the experimental meals were coded as high fiber no responsive feeding (HFNR) & low fiber no responsive feeding (LFNR) while the second phase was with responsive feeding and the experimental meals were coded as high fiber with responsive feeding (HFR) & low fiber with responsive feeding (LFR). Each of the four combinations of CF type and feeding style (i.e HFNR, LFNR, HFR, LFR) were repeated three times (three experimental CF meals, one per day on three consecutive days). To avoid any effect of the order of the distribution of the two types of CFs, infants were randomly separated into two groups, one starting by HF and the other by LF. For evident reasons, this cannot be done for feeding style and all meals without responsive feeding was come during a first period, and all meals with responsive feeding during a second period (table 3). Whether the effect of fiber was affected by responsive feeding and vice versa was also assessed.

A maximum of 45 min was allotted for the evaluation, and feeding sessions were considered terminated when child consecutively refused three mouthfuls and mothers confirmed that the infant had enough.

Table 3.3 Experimental design of the trails on the effect of CF fiber content and responsive feeding on food intake

Trial on the effect of CF extraction rates and responsive feeding on appetite																	
Adaptation				**ARF (Intake Measurements (g))**						**RFT**		**PRF (Intake measurements (g))**					
D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15	D16	D17	D18
Group 1				HF	HF	HF	LF	LF	LF			HF	HF	HF	LF	LF	LF
Group 2				LF	LF	LF	HF	HF	HF			LF	LF	LF	HF	HF	HF

G: group D: day HF. High fiber complementary food with high fiber LF: low fiber complementary food with low extraction rate PRF: presence of responsive feeding and ARF: Absence of responsive feeding RFT: responsive feeding training

3.13. Training on responsive feeding messages

A pictorial poster that is easily understandable by uneducated mothers was prepared by the fourth year students of Fine Arts and Design, Addis Ababa University (fig 3). The messages were also written explicitly below each picture. Caregivers and data collectors were trained for two days which was held at an open field. Before training is commenced, the field researcher asked motivating questions developed in Peru (Creed-Kanashiro, 2009). Mothers were asked to close their eyes and to think about their desires and wishes for the future of their infants for one minute. The trainer asked the mothers, how would you like him/her to be? What will her/his health is like? What will he/she be doing? What will he/she be working at? Then, after a minute the trainer told mothers to open their eyes and emphasise the positive images that all mothers have. The trainer explained how the mothers can achieve their dreams and started how to follow the formulated five key messages stepwise. The trainings were given at the end of the first period of the feeding trial (on days 11 and 12); the effect of responsive feeding behaviours on food intake was evaluated.

Fig. 3 Responsive feeding messages

3.14 Data Analysis strategies

The generated data was double entered into SPSS statistical software (SPSS version 20). The two entries were electronically compared; all extreme and otherwise susceptible values were confirmed or corrected. Results of continuous variables (i.e intakes) were presented as mean ±standard deviation (SD). Statistical significance was set at $P < 0.05$. Descriptive analysis was performed on socio-demographic variables. Significance of the effects of feeding style or fiber contents as affected by extraction rate of the flour used in the CFs were assessed using generalized linear model procedure, repeated measure.

CHAPTER FOUR

4. RESULT

The present chapter reports results obtained from a qualitative study that used focus-group discussion and in-depth interviews conducted among mothers (n= 22), HEWs (n= 12), and HDLs (n= 9) to test the acceptability and feasibility of feeding messages developed based on previous meal observations. The results of the within-subject cross-over design trial investigating the effect of fiber (high and low) in the presence and absence of the responsive feeding messages is also presented.

4.1 socio economic status and household characteristics

4.1.1 FGD and interview participants

Of the total number of participants (n= 43), 16 were interviewed (Mothers= 8, HEWs n= 4; HDL n=4) and the remaining 27 participated in the FGDs. The mean age of the mothers that participated in the FGDs was 28 years, while the HDLs were slightly older.

Most of the mothers were illiterate, and the few that had some formal education had less than five years of schooling. In line with the criteria of HEWs recruitment, all had at least completed grade 10. In contrast, half of the HDLs have not had any formal education. The study participants had on average 2-3 children. All participants had households with roofing made from corrugated iron sheet. According to individual interview and FGD more than 70 % of the mothers reported to have a food stock that would last them for one or more years. All the HEWs and few HDLs (n=2) were civil servants, whereas the remaining HDLs and all mothers were housewives. However, a non-negligible proportion of the housewives had some side business, which mostly consisted of producing traditional spirits known as *Areke*.

Table 4.1Characteristics of FGDs and Interview participants

	Individual Interview n= 16		FGD n=27	
	mean± SD	% (n)	mean± SD	% (n)
Age (years)				
Mothers/caregivers	28±1.23		28±1.23	
HEW	23.1±2.31		23.1±2.31	
HDL	27.35± 7.3		27.35± 7.3	
Family size				
Mothers/caregivers	2.8	*	*	*
HEW	1	*	*	*
HDL	2.2	*	*	*
Education				
Illiterate				
Mothers/caregivers		75 (6)		92.85 (13)
HDL		50 (2)		60 (3)
Formal education				
Mothers/caregivers		25(2)		7.14 (1)
HEW		100 (4)		100 (8)
HDL		50 (2)		40 (2)
Employment				
Civil servant				
HEW		100 (4)		100 (8)
HDL		50 (2)		40 (2)
Housewives				
Mothers/caregivers		100 (8)		100 (14)
HDL		50 (2)		60 (3)
Food stock > one year				
Mothers/caregivers		75 (6)		71. 43 (10)
HDL		75 (3)		60 (3)
CIS			100 (43)	
Religion (Orthodox)			100 (43)	

HEW: health extension worker HDL: health development leader FGD: focal group discussion CIS: corrugated iron sheet* Question was not asked

The FGDs identified that complementary foods were introduced after the child was six months of age (**Table 4.1)**. However, through the individual interviews, it was observed that most mothers started complementary feeding late (> 7 months). Few (educated ones) knew the optimal timing for introducing the child to complementary feeding.

According to the key informant's opinion, the first complementary food was most often gruel/porridge. *Injera* with *shiro* stew (family food) was also dominant. Other complementary foods include macaroni, spaghetti, eggs, and bread with tea. Even though HEWs and HDLs were providing advices to start giving gruel/porridge starting from six

months onwards, almost all mothers did not translate the advice into practice partly because they were overwhelmed by their daily work.

One mother in the discussion said that "*You come simply to talk to increase your salary…For example, my older children have had neither gruel nor porridge but, they had never gotten sick; nowadays, people always say nutrition, nutrition… to tell you frankly we (the older one) are much more stronger than you guys but we did not eat the prescribed 3:1(cereal: legume) porridge".*

Focus-group discussant: mother, 36 years old, mother with five children, no education

In the FGDs, several statements that relate to the participants' perception of what good nutrition were identified (**data not shown**). Foods were perceived as "giving blood" or ensuring "blood quality" and by implication ascertained that their consumers are healthy.

"*If human beings especially children do not have food, they become sick so called diarrhea or common cold*".

Mother, focus-group discussant

Others have reported that they have heard that a child should be fed vegetables, eggs, fruits and porridge, as they are considered good for the child's health. However, most related food shortage and malnutrition to susceptibility to diarrhea or common cold.

4.1.2Actual feeding Trial

Of the total number of infants (n = 32) 17 were male and the remaining 15 were female. The mean infant's age was 10.3 month **(Table 4.2)**. Most of the households were male-headed farming households (93.8%) with an average land size of 1.2 hectare. Most mothers were in their thirties and had 2 children on average. Almost all mothers except few didn't receive formal education. The average family size was 5.28. All had households with roofing made from corrugated iron sheet and all were a follower of orthodox religion. More than half of the households (56.3%) owned radio.

Table 4.2 Socio-demographic and household characteristics of mother-child (9-11 months) pairs (n=32) in Mecha district, West Gojam, Ethiopia **(actual trial)**

Variables	Mean±SD	Frequency (%)
Male headed household		30(93.8)
Farming households (farmer)		28(87.5)
Family size	5.28± 1.8	
Educational status of household head (illiterate)		27(84.4)
Number of siblings	2.25 ± 1.78	
Boys		17(53.1)
Infant age (mo)	10.125 ± 0.833	
Caregiver's age (years)	29.03 ± 5.23	
Caregiver's education (illiterate)		28(87.5)
Farming land size (hectare)	1.2 ± 1.02	
Religion (Orthodox Christian)		32(100)
Have CIS roofing		32(100)
Owns a radio		18(56.3)

CIS= corrugated Iron sheet

4.2 Acceptance of the responsive feeding messages

The Mothers perception about the acceptability and the feasibility of the five responsive feeding messages were investigated. The messages were discussed one at a time (**see discussion guide Annex I**).

Mothers were asked if they knew what responsive feeding is and if they have heard about it before. While, in general, mothers reported they had never heard about such messages, some had reported hearing about the importance of responsive feeding when they brought their child to growth monitoring program, but no explanation of what it means and how it can be helpful for the development of their child was provided.

According to the participants, among the responsive feeding messages, the easiest to follow was the one about verbal encouragement and congratulating the child for mouthful accepted, followed by sensitization to appropriate portion size. The discussion revealed that the mothers' understanding of the messages differed from the purposes they were conceived for. For example, the message about being attentive, face to face position or verbal encouragement with the child while eating was recognized as a positive attitude that the mother should always keep up to avoid accidents, make sure the child does not fall down or choke. However, according to the local culture and current practice, maintaining eye to eye contact was negatively perceived.

"When I look at my child while feeding I fear that s/he may get sick because a mother's eye is considered as an evil eye. That is what I have learned from my older family. Thus, eye to eye contact while feeding is not recommended. i.e. when I feed a child, I have to turn my neck back until he swallows it ."

Focus group discussant: Mother, 28 years old, no education

Regarding, the sensitization to appropriate portion size, some mothers reported facing difficulties to guess the amount of food a child should eat. Others believed that it would be difficult to exactly know the amount of food a child should eat, but they usually knew

the portion size of their children through the reaction that the children showed while they got hungry and became satisfied.

"I do have a child that is 10 months old , when he cries at early morning I recognize that he got hungry and give him what I have, usually a soft bread with tea. At lunch time I always give him enjera with shiro stew. If he starts playing during feeding I understand that he has become full".

Focus group discussant, mother, 31 years old and with no formal education

Concerning the message on avoiding distraction, most mothers mentioned that they can do it easily and it doesnot cost time and effort. However, two mothers' said that sometimes they walk the child, sing a song, show them birds, the moon, and cows or even allow them to play with a cat or a domestic hen to motivate and help feed their children.

Some messages generated greater discussion in terms of the convenience or possibility of applying it. This was the case for the message on letting the child to self-feed. Some mothers felt this was good because it gave the child the freedom, child could self-regulate its consumption and portion size, which promotes the development of the senses.

"Yes, I allow my child to self-feed because he is happy when he is fed by himself and I can also work other things"

Mother of one child, 26 yrs old

However, the majority, particularly older and illiterate mothers, tended to disfavour self-feeding. The major reasons were not tolerating their child getting dirty. Besides, this takes more time as they need to watch for child while feeding him/herself, which often takes longer time. It also adds activities such as washing the child to the already overloaded schedule.

"I do not allow my child to self-feed. He starts playing with the food or putting unwanted/dirty materials like soil. Even when I allow him to eat, he eats slowly, this takes up more of my time. I have to prepare food, coffee, and then prepare areke".

Mother of three children, 34 yrs old

Different reactions were also encountered in relation to feeding with patience and providing mouthfuls in response to a child's readiness. Many mothers mentioned that they do not have the patience to spend so much time feeding or waiting until the child finishes the food by him/herself. Primiparus mothers showed a greater acceptance of this message regarding feeding a child patiently as they are in a better position to take care of their single child than multiparus mothers. The limited time available to the mothers due to work, looking after other children or doing domestic responsibilities and knowing the consequences of letting the child self-feed represented obstacles to apply responsive feeding practices.

Regarding ways to disseminate these responsive feeding messages, the discussants recommended for the messages to be delivered to the mothers through religious leaders, HEWs, and HDLs. Peer to peer learning was also identified as one option of message delivery. However, the situation of each mother has to be considered to evaluate the possibility of putting the messages into practice (e.g. whether she has just one child or more than one), and they considered that the benefits of practicing them should be continuously repeated, such as the idea that the child will develop faster if you talk to him/her. They also mentioned that mothers forget and HEWs have to keep reminding them**.**

Mothers were motivated to commit themselves to put the messages into practice for different reasons, including "for the good of their children" and that "when they see an improvement in their children it would give them more encouragement to apply it". It also provides them with the opportunity to raise their children in a different way to their older siblings. At the end of the discussion, all mothers including those who were arguing about the acceptability and applicability of the messages also concluded that the messages will bring something new and wished they had taken this training when they raised their older children. They were eager because this was something new to learn in their role as mothers. Finally, mothers suggested that training should be given in a way that can entertain and keep them amused, i.e artistically, a drama that can able to demonstrate and promote advantages of responsiveness. This way, mothers can easily visualize the actual practice and positive response they get from the child. Most of the mothers had a desire of

having a child with good academic performance and economically successful e.g. doctor, pilot or teacher. So, whoever the trainer, s/he should train to mothers in a way that mothers could simply build impression, inculcate and internalize the advantages of being responsive. When training is given it should include as the mothers objective/target to improve child's economic achievement.

4.3 The feasibility of putting the messages into practice

Key informants were asked to assess their feeling about the applicability of responsive feeding messages by the mothers (Annex II).

Table 4.3: Feasibility score for each responsive feeding message

Messages	Feed patiently but with regular rhythm	Sensitization to appropriate portion size	face to face position, verbal encouragement while s/he is eating	Let the child self feed, touch and explore the food	Avoid too much distraction during feeding
Positive acceptance by mothers	0	4	6	1	2
Compatibility with the mothers' beliefs and culture	0	4	6	0	3
easing of doing it	0	6	6	0	1
Less cost in terms of time and effort	0	5	6	1	1
Compatibility with current practice of mothers	0	2	8	0	3
Total	0	21	32	2	10
Feasibility ranking	5	2	1	4	3

As table 4.3 illustrated that, the messages with the greatest acceptance and applicability were those linked to verbal encouragement while s/he is eating and sensitization to appropriate portion size, and those least accepted were let the child self-feed, touch and explore the food and feed patiently but with regular rhythm.

"*The family burden doesn't allow mothers to feed their children patiently. Because the burden is too heavy and they don't have assistance from their husbands, so they have to deal with what they have*".

(Key informant: Health extension worker)

Most of the participants mentioned that mother's having limited availability of time and the fact they considered that dedicating themselves to practice the messages took up more of their time for keeping up with their children as the main limiting element for putting the messages into practice. During the FDGs, the researcher found that though the messages are easy to adopt, there would be a need for more intensive training and communication programs in the wider community.

4.4 Infants' anthropometric measures and feeding practice

The mean weight-for-age, height-for-age, and weight-for-height Z-scores were -0.7±0.88, 0.38±1.062, and -0.72±0.99 respectively (**Table 4.4**). The infants' mean ± SD haemoglobin level was 10.97 ±0.7g/dl after adjusting for altitude (1,500m).

Table 4.4 Anthropometric measures and Haemoglobin level among infants aged 9-11 months (n= 32) in Mecha district, West Gojam, Ethiopia

Variables	Mean ±SD
Length (cm)	72.06±2.72
Weight (kg)	8.25±0.85
HAZ	-0.38 ±1.06
WAZ	-0.69 ±0.88
WHZ	-0.72±0.99
Haemoglobin (g/ dl)	10.97 ±0.71

All of the infants were breastfed till the time of the survey **(Table 4.5)**. More half of the mothers reported that giving first foods at six months old while the remaining 43.7% mothers were introduced their children after the seven months old. Mothers and occasionally sisters were the most responsible for feeding the child. The caregivers identified crying (93.8%), and the remaining 6.2% reported that looking at bowl as infants' behaviours in response to hunger. In contrast, spitting out food (62.5%), playing (25 %), sealing lips/clenching teeth (9.4 %), and other (3.1 %) were identified as behaviours related to fullness, and mothers' response to child food refusal were identified as try other food (59.4), take food away

(21.9%) and other (18.8%). Regarding to reaction to new food, 56.3% of the children had the habit of accepting while the remaining children were identified as not accepting even their home food, let alone a new food. 62.5 % of the children had small appetite where as nearly one third of the children were identified with normal appetite. 84.4 % of the children were enjoyable at meal time while 15.6 % were struggling to eat.

Table 4.5: Self-reported Infant feeding practices in Mecha district, West Gojam, Ethiopia

Variables	Frequency (%)
Infant ever breastfed	32/32 (100)
Was exclusively breastfed for 6 mo	31/32 (96.9)
Introduction to CF	
At 6 mo age	18/32 (56.3)
>7 mo	14/32 (43.7)
Who usually cares the child	
Mother	31/32 (96.9)
Sister	1 (3.1)
Infant's reaction when hungry	
Cry	30/32(93.8)
Looking at bowl	2(6.3)
Infant's reaction when full	
Clench teeth/sealing lips	3/32 (9.4)
Spit food	20/32 (62.5)
Play	8/32(25)
other	1/32 (3.1)
Caregivers reaction to food refusal	
Try other food	19/32 (59.4)
Take food away	7/32(21.9)
Other	6/32 (18.8)
Child reaction to new food	
Accept	18/32 (56.3)
Reject	14/32 (43.8)
Children appetite in general	
Small	20/32 (62.5)
Normal	12/32 (37.5)
Opinion towards meal time	
Enjoyable	27/32 (84.4)
Struggling	5/32 (15.6)

4.6 Proximate analysis of the complementary food

The proximate composition of the complementary food of both blends used for the meal observation was analyzed and the results are presented in **Table 4.6**. The complementary food (flours) had the following composition (per 100g on Dry basis): moisture (6.79%, 7.59%), fat (8.44%, 7.12%), protein (13.68%, 13.04%), carbohydrate (65.32%, 71.04%), ash (2.62%, 2.33), crude fiber (9.94, 6.74%) and energy (calculated by difference) of the flours were 412 and 413 Kcal/100gDM for HF and LF respectively.

Table 4.6: Proximate composition of HF and LF

Nutrient composition of CF formulations g/100 g DM		
	HF	**LF**
DM (%)	6.79	7.59
Fat %	8.44	7.12
Protein %	13.68	13.04
Ash (%)	2.62	2.33
Carbohydrates(g)	65.32	71.04
Fiber (g)	9.94	6.17
Energy (Kcal)/100g DM	412	413

† HF: high fiber LF: low fiber

4.7 Infant feeding

Most infants (96.6 %) were fed by their mothers, while sisters were also involved in infant feeding **(Table 4.7)**. The complementary food used for the meal observation, had an intermediate consistency. The amount of porridge served to each child was on average 183.3g. The mean CF intakes during the meal observation were 10.83 and 10.56 for LF and HF respectively. About 44 and 50 % of the infants consumed less than 10 g/Kg BW/meal for HF and LF while none of them could meet the minimum theoretical gastric capacity.

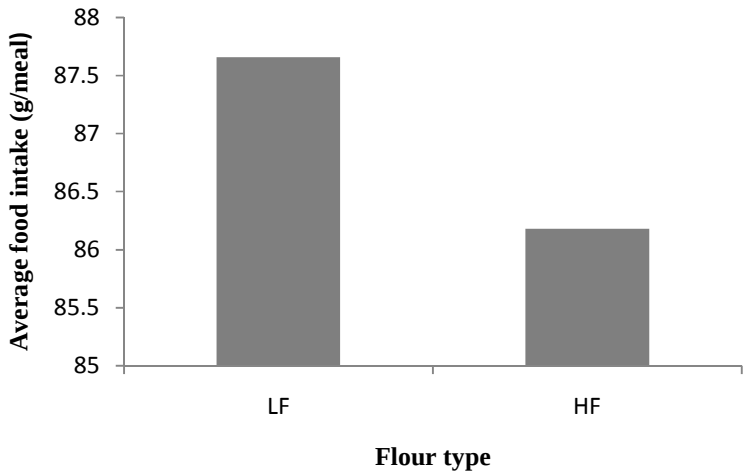
Table 4.7: Infant's feeding characteristics during actual trail

	Mean ± SD	Frequency (%)
Who feeds the child		
Mother		31(96.9)
Sister		1(3.1)
Energy gained from CF (Kcal/100 DM)	412.5± 0.5	
Average amount of food served (g/meal)	183.3 ± 9.96	
Food intake (g/kg BW/ meal)		
HF	10.56±6.23	
LF	10.83±6.6	
Food intake (g/kg BW/ meal) (HF)		
0-10		16(44.4)
11-20		17(47.2)
>20		3(8.3)
Food intake (g/kg BW/ meal) (LF)		
0-10		18 (50)
11-20		15(41.7)
>20		3(8.3)

HF: High fiber LF: low fiber BW: body weight CF: complementary food

4.8. Food intake of infants from high extraction rate flour and low extraction rate flour

As presented at **fig.4** the mean CF intake during the meal observation was **87.66** and **86.18** g/meal for HF and LF respectively which had a significant difference at P<0.05 which have low adherence to the minimum theoretic gastric capacity.

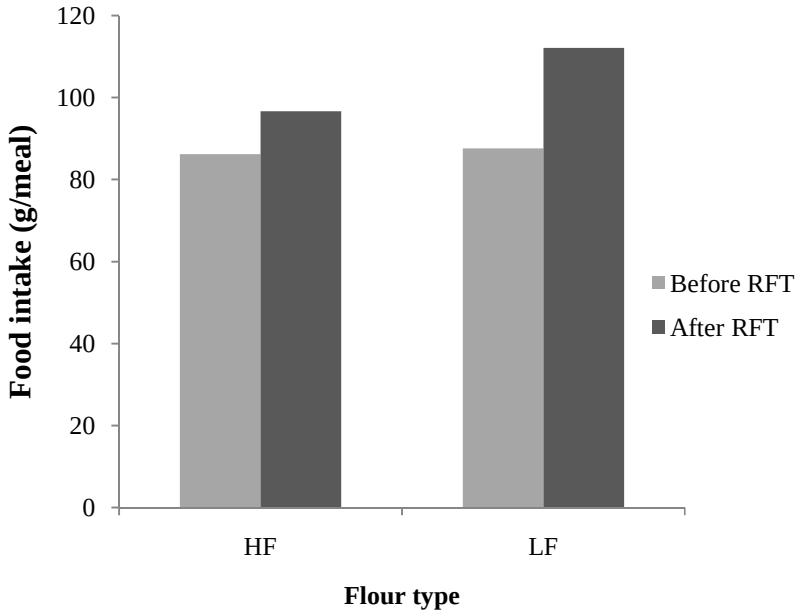


HF: High fiber LF: Low fiber

Fig.4 Average food intake of infants from HF and LF

4.9. Food intake of infants before and after responsive feeding training

As illustrated at **fig.5** the food intake of infants before responsive feeding were 86.18 and 87.66 g/meal for HF and LF respectively. While after the responsive feeding training the intake of infants was increased by **12.15%** and **27.83 %**for HF and LF respectively which had a significant difference at $P<0.05$. The food intake of the infants after gaining the responsive feeding training was higher than the usual feeding which clearly shows that responsive feeding training had a significant effect on intake. There was also an interaction between responsive feeing style and fiber content which had a significant difference at $P<0.05$.



HF: High fiber LF: Low fiber RFT: Responsive feeding training

Fig.5 Average food intake of infants before and after responsive feeding training

CHAPTER 5

5. DISCUSSION

The present study aimed to investigate the effect of fiber and responsive feeding style on food intake of infants aged 9-11 months. Prior to the main study five key context specific responsive feeding messages were formulated. The acceptance and feasibility of the responsive feeding messages was also assessed. Among the five responsive feeding messages verbal encouragement and sensitization to appropriate portion size were the easiest messages to follow whereas feeding with patience and self feeding were encountered different reactions. It was seen that mothers understanding of the messages was differed from the purpose they were conceived for. For example verbal encouragement, congratulations during feeding was positively perceived, however, maintaining eye to contact was perceived inversely. At the end of the arguments all caregivers were motivated to commit themselves to put the messages into practice for different reasons, including for the good of their children, economic achievement of their children and when they see an improvement in their child it gives them more encouragement to do it. Key informants also supported that except maintaining eye to eye contact all formulated messages are acceptable and feasible but needs to exert a great effort and intensive training.

The present study showed that food intakes of the infants were 10.83 and 10.56 g/BW/meal for LF and HF respectively which is lower than the recommendation however; the average food intake of infants even before receiving responsive feeding training was higher than reported by Tariku A. 2015 and Baye *et al*, 2013 (9 ± 4 g/meal/BW). Assuming a gastric capacity of 30 g/ BW/ day, 206-281 g per day of complementary foods with an energy density of 1.07-1.46 Kcal/g would meet the energy needs of infants' age 9-11 months (PAHO/WHO (2003)). In the current study the food intake of infants during the first period (without responsiveness) was not as large as 177 g/ meal. Relative to this figure, all infants had food intakes that were inadequate and far below the recommendation. This is in line with previous studies that also reported low food intakes among Ethiopian children. Baye *et al.*, (2013) reported that young children (aged 12-23 months) had food intakes that were below the minimal gastric capacity. More recently, the national food consumption survey also reported the low energy intake of infants and young children (NFCS, 2013).

In the present study, two types of factors of children's food intake were studied: one determinant was linked to the complementary food quality (the fiber content) and the other was linked to feeding style (the short training to five responsive feeding messages).

Although food intake of complementary foods prepared from higher extraction rate (HF) and prepared from lower extraction rate (LF) had significant difference with the usual feeding style of infants ($P=0.02$), after receiving responsive feeding training, intake of infants for porridge prepared from LF was much higher significant than HF ($p=0.00$).

The present study revealed that the fiber content had an effect on food intake. Infants had higher food intake of porridge prepared from low fiber flour as compared to high fiber content porridge ($p<0.05$). According to Gibson *et al*., (2010) complementary foods in rural parts of developing countries are prepared from high extraction rate. It is proven that complementary food prepared from high fiber foods have higher slower gastric emptying than prepared from low fiber foods. This slower gastric emptying especially in infants contributes to suppress the food intake of the subsequent meal.

A study conducted in adults shown that bread which had 15.1g fiber had higher slower gastric emptying than rice pudding (0.9 g of fiber) (Marciani *et al,* 2013). Likewise, Clark & Slavin, 2013 and Tucker, & Thomas, 2009), shown that flours with high fiber and whole grains were associated with lower body weight and prevention of weight gain compared to diets low in fiber. Moreover, IOM, (2001) and (2002) suggested that fiber delays the gastric emptying of ingested foods into the small intestine, which can result satiety. This delayed emptying effect also results in decreased appetite and food intake.

It is a common belief that poverty and low access to food and nutrients are the main reasons for under-nutrition, however, "equally important are caring practices, such as infant and young children feeding" (Engle, 1997).Some studies reported that malnutrition is not only due to poverty and lack of food but also due to difficulties in the interactions between caregivers and children (Moore *et al*., 2006, Ruel *et al*., 2003 & UNICEF, 2009).This is in line with previous studies that also reported the prevalence of under-nutrition in a food secure region of Ethiopia, which was not far from food insecure regions (Amha *et al,* 2015 & Teshome *et al,* 2009). This suggests that inadequate feeding styles may play an important role. More recently, a study conducted by Tariku A. (2015) reported that inappropriate feeding style (interaction of caregiver and children) was associated with inadequate food intake. The study suggested that among the five feeding behaviours classified by Moore *et al*. 2006, maternal positive responsiveness was associated with increased energy and food intake of the infants. Similarly, the present study confirmed that maternal responsiveness was evidently associated with food intake.

A cluster randomized trial in India has shown that Indian toddlers that received responsive feeding in addition to the WHO's recommendations on breastfeeding and complementary foods had higher energy and nutrient intake than those who received the complementary feeding recommendations alone (Vazir *et al*, 2013). Likewise, a study conducted in Vietnam and Burkina Faso reported that caregivers who encourage their children to eat more have been positively associated with acceptance of food. However, food refusal and low appetite were commonly observed and were associated with low food intake when caregivers were failed to encourage their children (Dearden *et al,* 2009; Mouquet-Rivier *et al*., 2016).

The present study strongly shows that food intakes of infants were higher after responsive feeding training which suggests that responsive feeding is possible strategy to improve food intake of infants. The study also confirmed that responsive feeding style had an interaction with the fiber content. This suggests that responsive feeding style can enhance the food intake of CF prepared from both HF and LF but when fiber content is too high, the appetite suppressing effect hinders the increase of food intake even after receiving responsive feeding training.

The major strength of this study is the standardization of the complementary food which had the same energy density, was prepared with the same cooking utensil, cooking time and consistency. Besides, data collectors and researcher were arriving early in the morning (6:30 am) at every door step aimed to control breastfed and any infant's food. Some children were breastfeeding during feeding trial, which was impossible to control during meal time but this was happened before and after responsive feeding in similar way, thus, the impact on food intake remains the same. Another strength of this study was the design of the trial (repeated measures), each infant was served as his/her own control which was used to adjust high inter-subject variability of food intake, then allowing to obtain significant effects. The study relied on a very narrow age range, and thus findings should not be used to children outside 9-11 months age. However, the objective was to focus on the 9-11 months age range when child starts to develop psychomotor skills but is unable to talk. This age range requires more engagement and responsiveness from the mothers which increases the programmatic implication of the study to be included in the National Nutrition program.

CHAPTER SIX

6. CONCLUSION AND RECOMMENDATION

The findings of this study have identified that fiber content and responsive feeding style had significant effect on food intake. Porridge intake of infants prepared from low fiber was higher than that of porridge prepared from high fiber. An intake of infants after responsive feeding was higher than the usual feeding style. Responsive feeding style can enhance the intake of CF prepared from both HF and LF but when fiber content is too high, the appetite suppressing effect continues to hinder intake of infants even after receiving responsive feeding training. Based on the major findings of this study, the following recommendations are drawn: Mothers should decorticate further the cereal and legume before milling for the preparation of composite flour for their young children.

-The formulated responsive feeding style should be integrated into the NNP package delivered by the Health Extension program

- Training should be given in a way that mothers can entertain and keep amused, i.e artistically, a drama that can be able to demonstrate and promote advantages of responsiveness should be in advance . Thus mothers can easily recognize that when children are responsively fed, s/he will be less likely face disease than the one who are not fed responsively.
- Training day and place should be appropriate with working time of trainee (caregiver). Though it differs from place to place, it would be preferable to train caregivers on Sundays via their religious leaders.

-A theoretically well known fact but not implemented practically is the introduction of complementary feeding and type of foods to be given to infants. What is practically going on in the community does not seem to go alongside the guideline that is taught to mothers. Uneducated mothers and even some HEWs did not exactly know the type of foods that should be given to infants. Thus, it is strongly recommended that adequate knowledge should be created and Policy implementers/ responsible officials should carefully monitor and evaluate what is practically on ground. Finally, findings of this study need to be supported with additional studies on larger catchment areas and bigger samples, preferably using a longitudinal study design.

7. REFERENCES

Aboud, F. E., &Alemu, T. (1995).Nutrition, maternal responsiveness and mental development of Ethiopian children.*Social Science & Medicine, 41*(5), 725-732

Aboud, F. E,Moore A.C.,Akhter, S. (2008) Effectiveness of a community-based responsive feeding program in rural Bangladesh: a cluster randomized field trail. *Maternal & Child Nutrition,* 4,275-286

Aboud, F. E., Shafique, S., &Akhter, S. (2009). A responsive feeding intervention increases children's self-feeding and maternal responsiveness but not weight gain. *The Journal of Nutrition, 139*(9), 1738-1743.

Amaha Kahsay Afework Mulugeta and Omer Seid. (2015). Nutritional Status of Children (6-59 Months) from Food Secure and Food Insecure Households in Rural Communities of Saesie Tsaeda-Emba District, Tigray, North Ethiopia. *International Journal of Nutrition and Food sciences 4(1):51-65*

AOAC, (2000) *Official Methods of Analysis*, 17th edition. AOAC, Gaithersberg

Baye, K., Guyot, J. P., Icard-Verniere, C., &Mouquet-Rivier, C. (2013). Nutrient intakes from complementary foods consumed by young children (aged 12–23 months) from North Wollo, northern Ethiopia: the need for agro-ecologically adapted interventions. *Public Health Nutrition, 16*(10), 1741-1750.

Bell, E. A., & Rolls, B. J. (2001). Energy density of foods affects energy intake across multiple levels of fat content in lean and obese women. *The American Journal of Clinical Nutrition, 73*(6), 1010-1018.

Bell, E. A., Castellanos, V. H., Pelkman, C. L., Thorwart, M. L., & Rolls, B. J. (1998). Energy density of foods affects energy intake in normal-weight women. *The American Journal of Clinical Nutrition, 67*(3), 412-420.

Bellissimo, N., &Akhavan, T. (2015).Effect of Macronutrient Composition on Short-Term Food Intake and Weight Loss.*Advances in Nutrition: An International Review Journal, 6*(3), 302S-308S.

Benelam, B. (2009). Satiation, satiety and their effects on eating behaviour. *Food and Nutrition Bulletin, 34(2), 126-173.*

Bentley, M. E., Wasser, H. M., & Creed-Kanashiro, H. M. (2011).Responsive feeding and child under-nutrition in low-and middle-income countries. *The Journal of nutrition, 141*(3), 502-507.

Birch, L. L., & Fisher, J. A. (1995).Appetite and eating behavior in children. *Pediatric Clinics of North America, 42*(4), 931-953.

Black, M. M., &Aboud, F. E. (2011). Responsive feeding is embedded in a theoretical framework of responsive parenting. *The Journal of Nutrition, 141*(3), 490-494.

Black, R. E., Allen, L. H., Bhutta, Z. A., Caulfield, L. E., De Onis, M., Ezzati, M., ... & Maternal and Child Under-nutrition Study Group. (2008). Maternal and child undernutrition: global and regional exposures and health consequences. *The Lancet, 371*(9608), 243-260.

Blundell, J. E., Burley, V. J., Cotton, J. R., & Lawton, C. L. (1993). Dietary fat and the control of energy intake: evaluating the effects of fat on meal size and postmeal satiety. *The American Journal of Clinical Nutrition, 57*(5), 772S-777S.

Blundell, J. E. (1996). Regulation of energy intake: appetite control and the potential for weight gain. *Progress in Obesity Research, 7*, 215-222.

Borzoei, S., Neovius, M., Barkeling, B., Teixeira-Pinto, A., &Rössner, S. (2006). A comparison of effects of fish and beef protein on satiety in normal weight men. *European Journal of Clinical Nutrition, 60*(7), 897-902.

Butte, N. F. (2000). Fat intake of children in relation to energy requirements.*The American Journal of Clinical Nutrition, 72*(5), 1246s-1252s.

Creed-Kanashiro H (2009). Responsive feeding in Peru: Application and monitoring of an intervention among families with small children from an area of the Ucayali region.

Clark, M. J., &Slavin, J. L. (2013). The effect of fiber on satiety and food intake: a systematic review. *Journal of the American College of Nutrition, 32*(3), 200-211.

Cloetens, L., Ulmius, M., Johansson-Persson, A., Åkesson, B., &Önning, G. (2012).Role of dietary beta-glucans in the prevention of the metabolic syndrome. *Nutrition Reviews, 70*(8), 444-458.

Davis, J. N., Hodges, V. A., &Gillham, M. B. (2006). Normal-weight adults consume more fiber and fruit than their age-and height-matched overweight/obese counterparts. *Journal of the American Dietetic Association, 106*(6), 833-840.

Dearden, K. A., Hilton, S., Bentley, M. E., Caulfield, L. E., Wilde, C., Ha, P. B., & Marsh, D. (2009). Caregiver verbal encouragement increases food acceptance among Vietnamese toddlers. *The Journal of nutrition, 139*(7), 1387-1392.

Den Hartog A, Van Staveren P, Brouwer ID (2006). Food habits and consumption in developing countries: manual for field studies. Wageningen Academic Publishers;

De Graaf, C., Blom, W. A., Smeets, P. A., Stafleu, A., &Hendriks, H. F. (2004).Biomarkers of satiation and satiety.*The American journal of clinical nutrition, 79*(6), 946-961.

DHS, (2013).Demographic Health survey. *Addis Ababa, Ethiopia*

Drewnowski, A. (1998). Energy density, palatability, and satiety: implications for weight control. *Nutrition reviews, 56*(12), 347-353.

DOA (2000).Annual progress report.Mecha District Department of Agriculture, Mecha, Ethiopia

EFSA (2010).Scientific Opinion on Dietary Reference Values for fats, including saturated fatty acids, polyunsaturated fatty acids, monounsaturated fatty acids, *trans* fatty acids, and cholesterol

Ello-Martin, J. A., Roe, L. S., Ledikwe, J. H., Beach, A. M., & Rolls, B. J. (2007). Dietary energy density in the treatment of obesity: a year-long trial comparing 2 weight-loss diets. *The American journal of clinical nutrition*, *85*(6), 1465-1477.

Engle, P. L., &Zeitlin, M. (1996). Active feeding behavior compensates for low interest in food among young Nicaraguan children. *The Journal of Nutrition*, *126*(7), 1808.

Engle, P. L., Castle, S., &Menon, P. (1996). Child development: Vulnerability and resilience. *Social Science & Medicine*, *43*(5), 621-635.

Engle, P., &Lhotská, L. (1997).Assessment, Analysis and Action to improve care for nutrition. *New York: UNICEF*

Engle, P. L., Bentley, M., &Pelto, G. (2000). The role of care in nutrition programes: current research and a research agenda. *Proceedings of the Nutrition Society*, *59*(01), 25-35.

Eshel, N., Daelmans, B., Mello, M. C. D., &Martines, J. (2006). Responsive parenting: interventions and outcomes. *Bulletin of the World Health Organization*, *84*(12), 991-998.

FAO/WHO (1992): International Conference on Nutrition Goals. World Declaration and Plan of Action FAO, Rome and WHO, Geneva

FAO (2003).Food Energy: Methods of analysis and conversion factors. Report of Technical workshops, Rome, *Food and Nutrition 77*

Gibson, R. S., Abebe, Y., Hambidge, K. M., Arbide, I., Teshome, A., &Stoecker, B. J. (2009).Inadequate feeding practices and impaired growth among children from subsistence farming households in Sidama, Southern Ethiopia. *Maternal & Child Nutrition*, *5*(3), 260-275.

Gibson, R. S., Bailey, K. B., Gibbs, M., & Ferguson, E. L. (2010).A review of phytate, iron, zinc, and calcium concentrations in plant-based complementary foods used in low-income countries and implications for bioavailability. *Food and Nutrition Bulletin*, *31*(2 suppl2), S134-S146.

Good, S., Shiferaw, Y., Davidsson, L., Randolph, T., &Hurrell, R. (2009). *Animal Source Foods and Nutrition During Early Life* (Doctoral dissertation, Diss., EidgenössischeTechnischeHochschule ETH Zürich, Nr. 18413, 2009).

Ha, P. B., Bentley, M. E., Pachón, H., Sripaipan, T., Caulfield, L. E., Marsh, D. R., & Schroeder, D. G. (2002). Caregiver styles of feeding and child acceptance of food in rural Viet Nam. *Food and Nutrition Bulletin*, *23*(4 suppl2), 92-98.

Halton, T. L., & Hu, F. B. (2004). The effects of high protein diets on thermogenesis, satiety and weight loss: a critical review. *Journal of the American College of Nutrition*, *23*(5), 373-385.

Hama, F., Icard-Vernière, C., Guyot, J. P., Picq, C., Diawara, B., &Mouquet-Rivier, C. (2011).Changes in micro-and macronutrient composition of pearl millet and white sorghum during in field versus laboratory decortication. *Journal of Cereal Science*, *54*(3), 425-433.

Hennink, M (2007). International focus group research – a handbook for the health and social sciences. New York: *Cambridge University Press*.

Holt SH, Miller JC, Petocz P, Farmakalidis E (1995).A satiety index of common foods. *European Journal of Clinical Nutrition*, *49*(9), 675-690.

Hotz, C., & Gibson, R. S. (2005). Participatory nutrition education and adoption of new feeding practices are associated with improved adequacy of complementary diets among rural Malawian children: a pilot study. *European Journal of Clinical Nutrition*, *59*(2), 226-237.

IOM (2001).Dietary Reference Intakes: Proposed definition of dietary fiber

IOM(2002). Dietary reference intakes for energy, carbohydrates, fiber, fat, fatty acid cholesterol protein and anion acids (Micronutrients).National academies press. Washington DC.

Krueger R, Casey M. (2000). Focus Groups – a practical guide for applied research. 3rd ed. USA: Sage publications;

Koletzko, B., von Kries, R., Closa, R., Escribano, J., Scaglioni, S., Giovannini, M., ...&Sengier, A. (2009). Lower protein in infant formula is associated with lower weight up to age 2 y: a randomized clinical trial. *The American Journal of Clinical Nutrition*, *89*(6), 1836-1845.

Leahy, K. E., Birch, L. L., & Rolls, B. J. (2008). Reducing the energy density of an entree decreases children's energy intake at lunch. *Journal of the American Dietetic Association*, *108*(1), 41-48.

Ledikwe, J. H., Rolls, B. J., Smiciklas-Wright, H., Mitchell, D. C., Ard, J. D., Champagne, C., ... &Appel, L. J. (2007). Reductions in dietary energy density are associated with weight loss in overweight and obese participants in the PREMIER trial. *The American Journal of Clinical Nutrition*, *85*(5), 1212-1221.

Little, T. J., Horowitz, M., &Feinle-Bisset, C. (2007). Modulation by high-fat diets of gastrointestinal function and hormones associated with the regulation of energy intake: implications for the pathophysiology of obesity. *The American Journal of Clinical Nutrition*, *86*(3), 531-541.

Lunn, J., &Buttriss, J. L. (2007).Carbohydrates and dietary fibre. *Food and Nutrition Bulletin, 32*(1), 21-64.

Lutter, C. K., & Dewey, K. G. (2003).Proposed nutrient composition for fortified complementary foods. *The Journal of Nutrition, 133*(9), 3011S-3020S.

Marciani, L., Pritchard, S. E., Hellier-Woods, C., Costigan, C., Hoad, C. L., Gowland, P. A., & Spiller, R. C. (2013). Delayed gastric emptying and reduced postprandial small bowel water content of equicaloric whole meal bread versus rice meals in healthy subjects: novel MRI insights. *European Journal of Clinical Nutrition, 67*(7), 754-758.

Martorell, R., Khan, L. K., & Schroeder, D. G. (1994). Reversibility of stunting: epidemiological findings in children from developing countries. *European Journal of Clinical Nutrition, 48*, S45-57.

Moore, A. C., Akhter, S., &Aboud, F. E. (2006).Responsive complementary feeding in rural Bangladesh. *Social Science & Medicine, 62*(8), 1917-1930.

Mouquet-Rivier, C., Traoré, T., Soma, A., Kaboré, C., &Trèche, S. (2016). Both encouraging feeding style and high energy density may increase energy intakes from fermented millet gruels eaten by infants and toddlers in Ouagadougou. *Appetite*.

Müller, O., &Krawinkel, M. (2005).Malnutrition and health in developing countries. *Canadian Medical Association Journal, 173*(3), 279-286.

NFCS (2013). Ethiopian National food consumption survey, EPHI, Addis Ababa, Ethiopia

Nguyen, V. H., Rivier, C. M., Eymard-Duvernay, S., &Trêche, S. (2010).Effect of extrusion cooking and amylase addition to gruels to increase energy density and nutrient intakes by Vietnamese infants. *Asia Pacific Journal of Clinical Nutrition, 19*(3), 308-315.

Onis, M. (2006).WHO Child Growth Standards based on length/height, weight and age. *Actapaediatrica, 95*(S450), 76-85.

PAHO, WHO. (2003).Guiding principles for complementary feeding of the breastfed child.*Washington DC*.

Pelto, G. H. (2000). Improving complementary feeding practices and responsive parenting as a primary component of interventions to prevent malnutrition in infancy and early childhood. *Pediatrics*, *106*(Supplement 4), 1300-1300.

Penny, M. E., Creed-Kanashiro, H. M., Robert, R. C., Narro, M. R., Caulfield, L. E., & Black, R. E. (2005). Effectiveness of an educational intervention delivered through the health services to improve nutrition in young children: a cluster-randomised controlled trial. *The Lancet*, *365*(9474), 1863-1872.

Rolls, B. J. (2000).The role of energy density in the overconsumption of fat. *The Journal of Nutrition*, *130*(2), 268S-271S.

Rolls, B. J., Castellanos, V. H., Halford, J. C., Kilara, A., Panyam, D., Pelkman, C. L., ... &Thorwart, M. L. (1998). Volume of food consumed affects satiety in men. *The American Journal of Clinical Nutrition*, *67*(6), 1170-1177.

Ruel, M. T., Brown, K. H., & Caulfield, L. E. (2003).Moving forward with complementary feeding: indicators and research priorities. *Food and Nutrition Bulletin*, *24*(3), 289-90.

Saha, K. K., Frongillo, E. A., Alam, D. S., Arifeen, S. E., Persson, L. Å., & Rasmussen, K. M. (2008). Appropriate infant feeding practices result in better growth of infants and young children in rural Bangladesh. *The American Journal of Clinical Nutrition*, *87*(6), 1852-1859.

Sara Antonio (2016). Caracterisation de la fraction fiber d'aliments de complement a base a de junes enfants ethiopiens. MSc report in nutrition and food science, University of Montpellier, France

Sguassero, Y., de Onis, M., &Carroli, G. (2005).Community-based supplementary feeding for promoting the growth of young children in developing countries. *Cochrane Database Syst Rev*, *4*.

Stewart, C. P., Iannotti, L., Dewey, K. G., Michaelsen, K. F., &Onyango, A. W. (2013).Contextualising complementary feeding in a broader framework for stunting prevention. *Maternal & Child Nutrition*, *9*(S2), 27-45.

Stubbs, R. J. (1996). Dietary macronutrients and glucostatic control of feeding. *Proceedings of the Nutrition Society*, *55*(1B), 467-483.

Tariku A., Baye K., &Mouquet-Rivier C., (2015). Effect of feeding style on food intake, appetite and nutritional status of infants.MSc Thesis, Addis Ababa University, Ethiopia.

Teshome, B., Kogi-Makau, W., Getahun, Z., &Taye, G. (2009). Magnitude and determinants of stunting in children under five years of age in food surplus region of Ethiopia: the case of west gojam zone. *Ethiopian Journal of Health Development*, *23*(2).

Thurmond VA (*2001).* The point of triangulation. *J Nurs Scholarsh;33:253–8.*

Tucker, L. A., & Thomas, K. S. (2009). Increasing total fiber intake reduces risk of weight and fat gains in women. *The Journal of nutrition*, *139*(3), 576-581.

Uhe, A. M., Collier, G. R., & O'Dea, K. (1992). A comparison of the effects of beef, chicken and fish protein on satiety and amino acid profiles in lean male subjects. *The Journal of nutrition*, *122*(3), 467-472.

Underwood, B. A. (2002). Health and nutrition in women, infants, and children: overview of the global situation and the Asian enigma. *Nutrition Reviews*, *60*(5), S7.

UNICEF. (2005). The State of the World's Children: Childhood under threat.Unicef

UNICEF. (2005). *The state of the world's children 2006: excluded and invisible*. Unicef.

UNICEF.(2009). Care for feeding counseling card. New York: UNICEF.

USAID (U.S. Agency for International Development) (2011). USAID's Infant & Young Child Nutrition Project (IYCN). Behaviour change interventions and child nutritional status: Evidence from the promotion of improved complementary feeding practices – literature review. Washington: IYCN

Vazir, S., Engle, P., Balakrishna, N., Griffiths, P. L., Johnson, S. L., Creed-Kanashiro, H., ...& Bentley, M. E. (2013). Cluster-randomized trial on complementary and responsive feeding education to caregivers found improved dietary intake, growth and development among rural Indian toddlers. *Maternal & Child Nutrition*, *9*(1), 99-117.

Westerterp, K. R. (2004). Diet induced thermogenesis. *Nutrition & Metabolism*, *1*(1), 5.

Wondafrash, M., Amsalu, T., &Woldie, M. (2012).Feeding styles of caregivers of children 6-23 months of age in Derashe special district, Southern Ethiopia. *BMC Public Health*, *12*(1), 1.

World Health Organization. (2002). Complementary feeding: report of the global consultation, and summary of guiding principles for complementary feeding of the breastfed child.

8. ANNEX

ANNEX I

Leading question for Focus Group Discussion with mothers

- What is food?
- What is Nutrition?
- What is malnutrition?
- Have you heard about stunting? (where and how) Would you please tell me in details
- What is the minimum amount of food you feed your children per meal? Explain in cups/bowl/spoons/serving size
- Do you think that the food that you give is adequate for the child? How do you assess the appetite of your children?
- Briefly describe the process how and where do you feed complementary food to your child/children?
- Did you allow your children to feed themselves? Have you encouraged your children to feed themselves?

ANNEX II

Leading question for Focus Group Discussion with HEWs and HDLs

- What is food?
- What is Nutrition?
- What do you know about malnutrition? Have you ever heard that a child is stunted or wasted? If so, would you please explain? What do you think the possible consequences of child malnutrition in this area (Amhara region)?
- What do you know about appropriate complementary feeding practice? Would you please explain it by your own words
- What is your opinion towards responsiveness and being active? What does responsive and active caregiver mean?

- Child malnutrition is a public health concern in our country especially in this region, the prevalence of stunting is much higher than elsewhere. According to different studies West gojjam is food secure but the prevalence of stunting is still comparable to food insecure areas of Ethiopia. What scholars suggested that food alone is not a grantee for child malnutrition rather appropriate feeding should be practiced. As a tool to address and combat malnutrition five key responsive feeding messages has been developed as follow
    - Eye to eye contact -face to face position, verbal encouragement
    - Sensitization to appropriate portion size
    - Feed patiently but with regular rhythm.
    - Avoid too much distraction during feeding,
    - Allow the child to self-feed by giving him a second spoon

As HEW and HDL what is your opinion towards those messages?

- Do you think the messages are easy to adapt in the wider community in terms Positive acceptance by the mothers, easing of applying it, Compatibility with the mothers' beliefs and culture, Compatibility with current practice of mothers and Cost in terms of time and effort? Which messages is easy to adapt and why?
- What strategies should we follow to put the messages into practice? How can we deliver the messages to the caregivers?
- What do you think the programmatic implication of the messages? How the messages can be included to the Health extension package?
- What possible challenges may we face to put the messages in to practice? What do you think the possible solutions?

Annex III

QUESTIONNAIRE FOR THE RESEARCH PROJECT: Effect of fiber content and responsive feeding style on infants on age range of 9-11 months, West Gojjam, Amhara regional state, Ethiopia

Zone: W. Gojam

Woreda: Mecha

Kebele: _____

Sub Kebele:_____

HH Code: _____

I. Household characteristics

1. Sex of household head 1. Male 2. Female

2. Age (in years) _____

3. Educational status:

1. Illiterate **2**. Primary school (1-8) **3**. Secondary school ((9-10+2)

4 .Higher education (TVET, College/university) **5**. Above (MSc and above)

4. Religion:

1. Orthodox 2. Catholic 3.Muslim 4.Protestant 5. Other

5. Livelihood strategy: 1. farmer

2. Civil servant

3. Merchant

4. Student

*5. other, please specify*_____

II. Economic status

6. How much land do you have? _____

7. Do you have a radio? 1. Yes 2. no

8. Is the roof of the house made of corrugated iron sheet? 1. yes 2. no

9. Do you have stored grains? 1. yes 2. no

If yes for how long it stored

1. 1 month 2.1 to 3 month 3. 3 to 6 months 4.> 6months

10. How many cows and oxen do you have?

Cow_____

Ox_____

Chicken_____

Sheep/goat_____

III. Caregiver characteristics

11. Relation to the child

1. Mother 2. Grand-mother 3. Sister 4. Aunt 5. other (specify)_____

12. Age (in years) _____

13. Educational status:

0. Illiterate 1. Primary school (1-8) **2**.Secondary school ((9-10+2) **3**.Higher education (TVET, College or University undergraduate) **4**. Above (MSc and above)

14. Religion:

1. Orthodox 2. Catholic 3.Protestant. 4. Muslim 5.Other

III. **Characteristics of the child**

15. Birth date: ___/_____/_____

16. Sex (tick one): 1. Male 2. Female

17. Birth weight of the infant (if known) _____

18. Does the child have brothers and sisters? 1. Yes 2. No

19 .if yes, how many in total? _____

20. Number of brothers and sisters in the following age groups

1. <12months 2.12-23 months 3.24-59 months 4.5-18 years 5.>18 years

21. Who usually takes care of the child?

1. mother 2. grand-mother**3.**brother/sister**4.**father**5.** others, *specify*_____

IV. Feeding practices

22. Is your infant ever breastfed? 1. Yes 2. No
23. Is your infant currently breastfed? 1. Yes 2. No
24. Was your infant exclusively breastfed for the first six months? 1. Yes 2. No
25. Is your infant introduced to solid/semi-solid foods? 1. Yes 2. No
26. If yes, when _____ (months of the infant) 1. at 6month 2. at 7-9 3. at 10-12 4. Above12 month
27. Have ever taken training on how to feed children? 1. Yes 2. No

28. If yes, did you get any knowledge that you had not before?

_____

_____

_____.

29. Do you know the amount of food your child can eat at one meal? 1.Yes 2. No

If yes, how much?

30. How do you know whether your child is hungry?

_____

_____

_____

_____.

31. How do you determine whether your child is full?

_____

_____

_____

_____.

32. What do you do when your child refuses to eat?

_____

_____

_____

_____.

33. What is your opinion towards meal time?

_____
_____
_____
_____.

34. Does your child dislike certain foods? 1. Yes 2. No

35. If yes, what do you do then: _____

36. What is the child's reaction towards new food?

_____
_____
_____
_____

37. If your child rejects new food what do you do then? 1

_____
_____
_____
_____.

38. How do you rate your child's appetite in general: 1. Small 2.Normal 3. High

39. Does your daily activity allow you to feed your child the way you want? 1. Yes 2. No

If no, specify the reasons: _____

40. Have you ever heard maternal responsiveness? In your opinion, what does responsive feeding mean? 1. Yes 2. No

_____
_____
_____
_____.

41. Do you allow your child to eat by him/her self? Would you please explain why?

_____
_____
_____
_____.

V. Feeding episode observation

Date_____

Name of data collector _____

Name of the child _____ Type of flour 1.HF 2. LF

Porridge preparation

Flour weight: 54 g water: 196 g cook 5min from boiling check water evaporated= 50g

42. Total weight (pan+cover+spoon+flour+water)

1. before cooking _____

2. after cooking _____

43. Porridge consumption

1. Time beginning of consumption _____ 2. end_____

Weight of porridge Before consumption Weight (bowl+spoon+porridge) _____

Weight of clean cloth _____

After consumption Weight (bowl+spoon+leftover) _____

Weight of the cloth after cleaning the child_____

Termination of feeding episode

44. How do your rate your child's appetite today

1. Less than usual 2. As usual 3.more than usual

For data collector only

45. During feeding episode please rate how much the mothers acts for the below listed actions

No	action	Score (e.giiii….)
1.	Force feeding	
2	Self feeding	
3	Verbal encouragement	
4	Breast feeding	
5	Consumption by others	
6.	Drunk water	

46. Did the child eat solid food before we came? 1. Yes 2. No

47. If yes, describe the type of food _____

VI. Anthropometry (measure up to 2 equal or approximating to 100g or 1mm)

6.1. Weight

1st measure (at the beginning)	**2nd measure (week later)**	**3rd measure (at the end)**
_____ Kg	_____ Kg	_____ Kg
_____ Kg	_____ Kg	_____ Kg
_____ Kg	_____ Kg	_____ Kg

Measurementswere done before starting the study then every week until completion of the study

6.2. Length

1st measure	**2nd measure**	**3rd measure**
_____ cm	_____ cm	_____ cm
_____ cm	_____ cm	_____ cm
_____ cm	_____ cm	_____ cm

VII. Hemoglobin readings after corrected for altitude (1500m)

Readings	**Hb values**

Annex IV

Some pictures taken at laboratory and field

Roasted Pea

cleaning of unwanted materials

Decortication

Trial of standard porridge preparation

Demonstration how to prepare standardized porridge

when data collectors practicing to prepare standardized porridge

Responsive feeding training to mothers (Enamirt kebele)

Responsive feeding training (Enguti kebele)

FGD with Mothers