Can Indigenous Foods Play Role as 'the Food of Survival'?

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Abstract — The indigenous foods are 'the way of life' of the people in rural Sudan and are considered 'the food of survival'. Traditional/indigenous foods provide inexpensive, safe, nutritious foods throughout the whole year. These indigenous foods contribute to diversify of the diet of rural people in normal times and alternative foods that crucial to their survival during times of food shortage. Indigenous foods have the nutritional values; are both palatable and enjoyable, in addition to their potential health benefits. Indigenous techniques to process and preserve food materials are rooted in the traditional cultural, are economically practicable and more appropriate for the local contexts. Indigenous foods and traditional processing techniques are based on empiricism and bring to bear a sense of the connections of indigenous people to their surrounding environment. This is important as it enables those people to relate their knowledge to solving problems in their context. It indicates how indigenous people are in 'harmony' with their surrounding environments for collective survival. The paper gives a brief description of some indigenous foods from various rural areas of Sudan.

Index Terms — Traditional/indigenous foods, Rural Sudan, conflict/post-conflict areas.

I. INTRODUCTION

Food insecurity can be caused by several factors including, but not limited to, environmental and socioeconomic crises. Poverty is a major challenge that has defied solutions despite well meaning policies and programs. In fact, climate change, poverty and food insecurity are strongly interlinked, thereby suggesting a coordination of policies in these three targeted areas of intervention [1]. Moreover, civil conflicts and military wars come in addition to make things worse. All these crises continue to pose challenges to household food security particularly in rural and conflict/post-conflict areas of Sudan. Given the various efforts so far, much still need to be done. Access to sufficient foods in terms of quantity and quality is basic concerns of attaining household food security. Household food access is defined as the ability to acquire sufficient quality and quantity of food to meet all household members' nutritional requirements for productive lives [2]. That is, ability to produce or procure sufficient amount of foods to meet people dietary needs for healthy and active life.

Sudan continues to face the challenges to provide rural and post-conflict communities with sufficient, affordable, safe and nutritious foods. Yet the unasked question is – how did vulnerable people in rural and conflict/post-conflict, with a limited income capacity and limited available

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resources create sustainable lives? In other words, the ability of these communities to sustain food supplies which at the same time nutritionally adequate and culturally preferences. The concern, which is of a particular importance, the question whether the food security can be achieved without detriment to the people's indigenous foods or accepting and respecting 'their way of life'. How, and to what extent, can existing traditional foods contribute to the search for homebased solutions to food shortages problems and challenges? Traditional processed foods are considered shelf-stable even under higher temperatures, thus are seen as critical to people survival in rural and conflict/post-conflict areas. During food shortages 'crises' due to the limited foods available for survival, people have resurrected the relationship with rooted-traditions and their environment. The indigenous foods enabled people to live through famines in the 1980s in western Sudan more than on relief foods. Traditional foods still exist and a return to tradition is being forced by the limited availability of the resource, ongoing conflicts, and by foods high prices. Traditional foods are tailor-made answers to local opportunities and challenges.

II. CHALLENGES AND OPPORTUNITIES

A. An Overview

There is an ongoing challenge for the gravity of food shortages. Indigenous foods represent the fruit of valuable cultural capital and a concrete resource. The proper utilization of these resources would provide a basis for sustainable food supplies. An appreciation understanding the nature, content and context of indigenous food processing and preservation may represent a foundation for food stability and as a prerequisite for achieving household food security. Understanding how it practices and supporting its continuation is the best approach for achieving food security for people in rural and conflict/post-conflict areas. The art of traditional processing and preserving techniques need to be promoted by adjusting their criteria to ensure quality control characteristics of the final products without losing their attractive attributes. In order to be meaningful, food security interventions must be based on the daily practices of the indigenous people on the ground. Pro-poor initiatives have to be aligned with overall goals of food security policy in Sudan. Locally appropriate solutions to the issues identified, requires working with local people who understand in detail what conditions, contexts, and other factors are at play that will contribute to or impede the success of the policy/program.

Traditional foods provide optimum solutions given the availability of raw materials and nutritional considerations. So far food security policy and program continues ignoring and inadequately account for indigenous foods. This could

have implications for ensuring food security at the national level. Indigenous foods need not focus on entirely new initiatives but supporting rural people to build upon their own strengths. Policy-makers and concerned actors need to think 'outside of the box', look at the ever-practicalsolutions. Additional efforts should be perched towards workable food security frameworks that fit for different areas in the country. The success of any food interventions depends upon the long-term vision and strategy of the process. Food security policy appears to be based on a relatively narrow agronomic perspective. Sudan is setting up a growth acceleration strategy for short and medium term, among which agriculture is the main focus to eliminate food insecurity. Government efforts to address food security challenges have traditionally been through National Strategy for Agricultural Development. Examples include the Agricultural Renaissance (AR) and Green Resurrection (GR) programs. However, both AR and GR programs did not succeed in increasing neither productivity nor food security in the country [3]. Indigenous foods could offer some insights on how these survival foods may best be promoted among the rural people. The indigenous foods as 'the food of survival' in rural and conflict/post-conflict areas seem to be more practical and sound sensible. 'Traditional' and 'indigenous' foods are used interchangeably in this paper.

The government should be better equipped to manage and sustain the response to food shortage that can serve as a better option to achieve food security in a sustainable way. The main lesson learned from previous food shortage and famine crises in Sudan (in the 1980s and 1990s) is the necessity to have some alternative resources. That way the country does not have to be overly dependent on food aid. Aid has always been a means of manipulation. Sudan really should not need for aid, no matter the type, if the resources are well managed and the indigenous food are well developed. The existing international aid has not been able so far to solve the food insecurity problem in conflict areas of Sudan as in elsewhere. References [4] find that aid has no clear effect at all, positive or negative. Their finding holds across time periods, regardless of the donor or type of aid, and regardless of the characteristics of the recipient country. One challenge of aid is the high administrative costs, even in food crisis situations. How these costs should be reduced in aid meant for the affected-vulnerable people, especially where it only leaves a small percentage for these final beneficiaries.

B. Sudan Background

Sudan is located in northeastern Africa. Sudan is one of the most geographically diverse states in Africa. The country population forms a great mosaic of ethnic, tribal, religious and cultural affiliations and traditions. According to the last Sudan's Population Census people live in rural areas and nomad constitute about 70% of the total population, as well the majority of the African population lives in the rural areas. Rain-fed agriculture remains the dominant source of staple food production and the livelihood foundation of the majority of the people in rural Sudan. The Sudanese agriculture is based on three farming systems, the traditional and mechanized rain-fed agriculture and the irrigated sector. However, rain-fed agriculture is also important for access to food, employment, and income.

Climate change and climate variability are regarded as ones of the several interacting factors that have a much greater relative impact on agriculture, which is the mainstay of the rural population. The adverse effects of climate change are already evident and natural disasters are becoming more frequent and devastating. Impacts of climate change on agriculture include potentially significant yield losses of key staple crops, including maize, sorghum, millet, groundnut, and cassava [5]. Climate variability in Sudan, as well in Africa, is expected to worsen food situation through extreme events, such as floods (see Fig. 1 flood in eastern Sudan) and droughts, which are increasingly becoming more and more common, rather than rare. The impacts of these hazardous events are most acutely experienced by rural population whose livelihoods depend principally on natural resources. It is evident that the poor will be the most vulnerable to these changes in terms of risk to their production systems because they have fewer assets to call upon in order to cope with extreme events such as prolonged droughts [6]. Livelihoods of the post-conflict communities can be characterized as "livelihoods at risk" in most African conflict-areas. For instance, most people in post-conflictaffected areas in Darfur of western Sudan have no access to their pre-conflict livelihoods, which are based on a combination of farming, herding, trade and labour migration. Nowadays, large numbers of internally displaced persons (IDPs) in Darfur have become dependent on daily laboring, firewood trade and other petty trade [7].



Fig. 1. Flood in eastern Sudan in 2015. Source: General Directorate of Civil Defense in Sudan.

III. RESEARCH METHODS

The study draws on interview with selected key informants and direct observations. Indigenous food processing and preservation activities have been documented through in-depth interviews with key informants and direct observations. In addition, some of indigenous food processing and preparation methods are well known to the researcher who is sometimes involved directly or indirectly in these food activities. Data on direct observations were recorded via detailed ethnographic fieldnotes (in as much detail as possible) and photographs. Key informants were selected on basis of particular trait. Key informants are those who have expert knowledge on indigenous foods to answer the probing questions and provide in-depth information on indigenous foods 'the food of survival' in Sudan. In selection of key informants both purposive and snowball sampling techniques have been used. First eleven informants were purposely chosen based on their knowledge and expertise of the indigenous foods practices. Then those informants helped to identify a group of people from different parts of Sudan who have a wealth of knowledge and experience about indigenous foods and more importantly they are willing to share their knowledge. Therefore, the key informants represent various ethnic groups from different parts of Sudan. Some of the key informants have lived in war-affected areas for a length of time. Some of them were survived the terrible famine of 1984-85 in Darfur region. In-depth semi-structured questions have been freely flowing and allowed the informants to provide their knowledge and expertise on the indigenous foods. Interviews with key informants were recorded and written and further analysis was based on these notes taken. The study conducted in Khartoum State and South Darfur State in 2016 over four month period of times. Moreover, the study draws on findings from field surveys from previous published and unpublished studies undertaken by the author in some rural areas of Kordofan and Darfur of western Sudan (Ibnouf, 2011, 2012 as listed in the bibliography). Qualitative information generated during interviews with the key informant interviews was sorted into themes then summarized and the results were presented in the study. This study also uses review of literature to provide an overview of contribution of indigenous foods to household food security. The Indigenous foods of the Sudan are numerous and varied as have been presented in details by Professor Hamid A. Dirar in his book "The Indigenous Fermented Foods of the Sudan: a Study in African Food and *Nutrition*"¹.

IV. THE WAY OF LIFE OF RURAL PEOPLE

The ways communities are addressing and can redress ongoing food shortages; how rural communities have interacted with their changing environment? The formidable foods challenges facing people in conflict/post-conflict areas are well-known. Security issues and political stability are important features in the long term solution to food insecurity. Post-affected communities struggle with basic existence, increasingly the role of traditional and wild foods, and even insects, are seen as critical to their survival. Many of the rural people depend on natural resources for their survival. Declining rainfall and frequent drought have major

¹ Professor Hamid A. Dirar, in his book: "The Indigenous Fermented Foods of the Sudan: A Study in African Food and Nutrition", which published in 1993, describes in detail the process of food preservation, its scientific factors, nutritional value, uses, functions, and meanings as perceived in Sudanese culture, and he addresses misconceptions about preserved indigenous food.

impacts on both the natural resource base and human systems in sub-Saharan Africa [8], including Sudan. Most of the agriculture farming systems in Sudan as well in most African countries is rain-fed. Crop production is thus highly vulnerable to the vagaries of the rainfall. The logical question that may be raised is what rural people usually done with the limited available resources? How rural people live more sustainably in such situation? The simple answer might be that culturally adapted indigenous foods are readily available to cope with the situation. That is, the subsistence activities on which the lives of most rural people depend, and are oriented around securing food are processing and preserving of crops, animals, and wild products. They depend on these indigenous foods for their survival and existence. Making the best use of their limited resources becomes often a way of life for the rural people with associated adaptive social, cultural and economic way of living. The way of living is both cost-effective and sustainable. The people's summit, in contrast, think about alternatives outside of science, technology and the market, which are the only responses considered in the 'official' debates. Therefore, the role of indigenous foods, as 'the survival foods', in meeting food security for the people in rural Sudan and even in conflict/post-conflict areas, need to be recognized.

Sudan's climate limits the production of food for only one rainy season (June to October). Most of staple foods (cereals, and vegetables) are only seasonally available, however processing and preservation methods based on indigenous knowledge allow the storage of these products for longer periods. Rural people might be poor in income but have valuable indigenous knowledge about ways of living sustainably. There are still piles of rich knowledge of traditional practices which is embedded in their cultural values. The rural are the primary custodians of the traditional foods practices. The indigenous foods are primarily based on their local experience and have been evolved over time and transmitted over generations through practices. These indigenous foods act as emergency safety nets during periods of shortage and even during conflicttime. Traditional foods are still important in the context of sustainable food security of rural areas today and in the future.

Every ethnic tribe has their own ethnic heritage foods. However, innovative solutions to produce 'affordable' and 'accessible' food by each of these tribes may lead to the possibility of achieving food security in the whole country. Indigenous foods are plentiful and varied in rural Sudan as culture plays a fundamental role in people eating habits. Indigenous foods techniques evolved through trial and error process occurring over several generations and they are usually adapted to the local cultural context. The consumption of indigenous foods has been and is still being as 'the food of survival' in rural and in conflict/post-conflict areas. Indigenous knowledge plays a critical role in ensuring survival of people who living in the conflict-affected rural areas of western Sudan [9].

There is a rich and diverse range of indigenous foods. Notably, indigenous foods eaten by the people in north Sudan vary from those in western Sudan and so forth. Indigenous foods have been developed by the local people using traditional methods and locally available raw materials. The cultural conditions create differences in traditional foods that based on local knowledge, beliefs and practices. Rural people believe that the use of the indigenous technique and practices in processing and preserving food products is often contributed to increase its consumption and its availability. Most of the indigenous foods may seem unpleasant to urban people but they are attractive and nutritious and widely enjoyed by rural people. Meat, intestines, and fish, in addition to okra, tomato, red pepper, grain, dairy products and drinks, fat, grass and leaves are highly processed, meticulously preserved, and have their own indigenous names [10]. Some inedible wild products are processed into conventional food products, such as makhait (Boscia senegalensis). Chemical analyses revealed that some traditional processed products are richer in energy, protein, essential amino-acids, unsaturated fatty acids, vitamins, and minerals than the raw materials. More recognition of the role of indigenous foods in achieving household food security will give rural people a sense of the value, ownership and importance of traditional resources. These may assist to build resilience food security strategy for rural and post-conflict areas. The principle of ownership should not only apply for governments, but for rural society as well. Ownership implies more respect for the autonomy and priorities of the rural people. It means accepting that rural people are much more than just implementers of policy designed by government. This will only happen if the policy for setting and achieving food security remain multistakeholder. These, unfortunately, do not appear to exist so far.

V. SURVIVAL FOODS FOR SUSTAINING FOOD SUPPLIES

What is required to sustain household food supplies in long-term? This will require a better understanding of the local reality. That is, the various issues that affect sustain food supplies at household level. Declining crop yields and loss of livestock due ongoing extreme weather events are among the causes of food shortage in many areas of rural Sudan. The local communities in dry-land region have survived till today with a fast population growth rate is an indication that they have developed indigenous mechanisms and strategies to cope with these droughts [11]. Daily and long-term survival depends on finding alternative food supplies. Indigenous foods have evolved as a sound adaptation to local realities, and keep the people access to adequate food all year round. Shelf life foods are a part of the survival foods for rural people and people in conflict/post-conflict areas in Sudan. Under unrefrigerated storage, meat, milk, and fish can spoil quickly because bacteria can multiply so rapidly in these foods. Long shelf foods can be made through dehydrated, salted, fermented and dried of raw food materials.

What is the best choice? Based on their knowledge of their surrounding environments, people in rural and conflict/post-conflict areas are very well knowledgeable on what is best for their survival in such environment. Their food habits are based on ingenious staple foods and are integral component of dietary culture. Understanding what their indigenous food are and why they are practiced is the first priority for supporting their survival strategy, which is local self-reliance, and socially and economically sound. Dried and fermented foods together with the food products that can be gathered from the wild have saved lives especially those of vulnerable people in the past (during famines) and in the present (in times of shortage) and may be in the future.

A number of indigenous processing techniques are often employed in Sudan to preserve food items in times of abundance for times of scarcity. Combination of two or three indigenous food processing techniques is common practices, i.e. fermentation and drying (Kawal) or salting, fermentation, and drying "shermout", germination, fermentation and drying "abreh/hulu-mur" [12]. (The traditional food processing techniques are added to the shelf-life of seasonal produce and therefore contribute to the continuing supply of food during dry seasons. All of the preceding approaches to preservation of foods have contributed to the safety and stability of foods available to consumers by controlling or eliminating microbial populations in foods [13].

A. Art of Possibility

The preparation of many indigenous foods remains as unwritten household arts. Sudanese people invented unique indigenous food products. Their previous experience, proper utilization of local tools and technologies and maximum use of the limited resources lead them to ensure the day-to-day survival. The ongoing challenges (drought, conflict, food shortages) allow the survival and renewal of culture and are important generators of innovation. Indigenous foods can be made based on the local staple food, animals and their byproducts, and wild species ingredients that are easily available, inexpensive, and familiar to the people.

In western Sudan in particular almost all parts of slaughtered animal can be eaten. Nothing is left to waste. A variety of animals' by-products such fatty tissue, bones, hooves, offal and feet may be considered as wastes being thrown away are often processed to edible foods by rural people in western Sudan. Bones are often considered as waste products, however in Darfur and Nuba Mountains, bones are fermented into a variety of products which include doddery and kaidu-digla. Dodery is produced by chopping bones into small pieces and placing them into fermenting vats, they are subsequently covered in water, left to ferment for three days. Fermented bone, marrow, fats, and tendons crushed into a paste and mixed with combu (alkaline potash which is the ash from burnt sorghum stalks – see Fig. 2), the mixture is returned to the fermenting vat for a further two to five days, the final product is rolled into balls and has a shelf life of up to two months [14] and also indicated by key informants). Another product "Kaidu digla" is made from the vertebrae of the backbone, these are chopped into smaller pieces and then sun-dried. After drying they are pounded with stones; mixed with water and salt; molded into balls and allowed to ferment (ibid). Miriss is made from layer of fat surrounding a lamb's stomach. Uncooked layer of fat mixtures with some combu for two days before pounded to a soft paste which is usually stored in burma (Fig. 3 miriss). Traditionally, combu is one of the main ingredients in the making of miriss, and it contributes to the special flavor. Miriss paste is mixed with crushed peas, dried okra, onions and spices to make highly flavored mulah (stew, sauce, soup). The finding of reference [14] is congruent with this study that internal organs such as small intestines with strips of the lungs, heart, kidneys, liver are first cleaned, dried direct sun and then all pounded together and mixed with some combu (potash) and molded into a ball and allowed to slowly ferment and then dry again, to give which locally known twini-digla. Fermentation and then drying are essential for effective long-term these meat-byproducts storage.

Combu



Fig. 2. Combu (potash which is the ash from burnt sorghum stalks).

Miriss paste is fermented pure fat



Fig. 3. Miriss paste is made from fermented of pure fat.

In rural western Sudan, a favorite choice to the meat substitute is kawal (see Fig. 4 kawal). Kawal is one of the most popular dishes in western Sudan (Darfur and Kordofan). Kawal is derived from the two-week long fermentation of the pounded green leaves of the kawal (Cassia obtusifolia, called also Senna obtusifolia Linn). Senna obtusifolia Linn (commonly known as 'Sicklepod') grows as a weed during rainy season throughout the tropical regions of the world [15]. The leaves place in a pot made of mud and buried under the ground for some time because the fermenting bacteria do not work in an open air. Kawal is considered 'protein rich' traditional product. As point-out by references [15] the green leaves of the plant are fermented to produce a high-protein food product called "kawal" which is eaten by many people in Sudan as a substitute of meat. The oil seedcake remaining after oil extraction from sesame seed (Sesamum orientale) is fermented for a week to make another meat substitute, called locally sigda. Kawal and sigda are dried after fermentation in the form of hard, irregular, small balls and may keep for years.





Hibiscus/Roselle (Hibiscus sabdariffa) which called locally karkade is used in western Sudan to serve different nutritional goals such as flowers are used for producing juice or hot-tea and seeds are used for preparing meat substitute, known as furundu and while leaves are widely used in preparing indigenous stew called locally angrah. Angrah stew is made from fresh hibiscus leaves with onions, peanut butter, flour and combu (potash). Furundu (Darfur) and Kunafa (Nuba Mountains) is fermented food product made of karkade seeds. Furundu is prepared by cooking the seeds of hibiscus then fermenting in a round earthenware pot (called locally burma) for more than a week. Hibiscus seeds are crushed to fine powder, alkaline potash or combu and water added and mixed to squeeze oil out [16]. The paste is incubated for 10 days until fungal growth is seen, and then it is mixed again for two days. It is consumed like kawal in Darfur (furundu stew), or mixed with fermented sorghum or millet dough as nasha (thin gruel, soft porridge) or acida in Nuba Mountains [16]. References [17] indicate that hibiscus/ roselle seeds are great source of protein and amino acid composition for human nutrition, because seeds are rich in the essential amino acids and high content of unsaturated fatty acids. According to references [18] furundu raised from the cooked hibiscus seeds have considerable amounts of essential amino acids and minerals and the HClextractability of minerals were improved by furundu preparation.

Red hulu-mur (meaning sweet-sour) is a non-alcoholic unique beverage – see Fig. 5. Hulu–mur (called also abreh) is a very common refreshing soft drink for Ramadan (the Muslim holy month of fasting). It involves three separate stages of production: germination, fermentation, and baking. Red hulu-mur is made from fermented dough prepared with equal amounts of flours from malted and un-malted sorghum bicolor flour. The half patch of sorghum grain is moistened with water and allowed to germinate for six days. First, sorghum grains are soaked in water overnight until softened. Then the softened grains are spread over palmfiber mats or burlap and covering with moist sheet of burlap and kept in a dark place and sprinkled from time to time with water to keep them moist - the germinated grain called 'zereah.' which subsequently sun-dried and grinded. The other half of un-germinated sorghum grain is milled into fine flour and cooked directly into slightly thinner porridge and then malt flour is added to the porridge while is still hot and mixed together with a wooden stirrer. Selected ground spices such as ginger (Zingiber officinate), cinnamon (Cinnamomum zeylanicum) and lesser galangal (Alpinia officinarum), coriander, black cumin, black pepper, in addition to the liquid additives extracts of red Roselle (Hibiscus sabdariffa) and tamarind (Tamarindus indica), cloves (Syzygium aromaticum), and dates (Phoenix dactylifera) add to the mixture dough to improve flavor after twelve hours and then allow to further simultaneous fermentation for two days and a half. Resulting red-brown colored fermented dough has a sweet and somewhat astringent taste is then diluted with water to consistency of batter. Then the mixture is baked into flat sheets and then the sheet folded before lift. Baked-sheets are left to dry in the shade for two days and may be stored for years. Hulumur sheets is crumbled and soaked in water for about two hours, strained and sweetened and served cold.



Fig. 5. Hulu-mur.

Camel cheese is difficult to produce under the conditions used for milk of other livestock [19]. However, nomadic people are usually made a type of a grainy indigenous cheese called kush-kush [20]. kush-kush is made from fermented camel milk and is usually eaten with sorghum porridge. Kush-kush camel cheese has other advantages as well as it is high in vitamins, low in cholesterol and low in lactose, making it suitable for people who are allergic to other dairy products [21]. kush-kush is made by placing raw milk into tanned goatskin leather bag (si'ins) and shaking until a solid lump of butter separates from the liquid (fursa). After extraction of butter sour milk is allowed to proceed further until curd is separated from whey, then curd is collected and dried under sun and the end-product is kushkush a granular cheese [14]. Kush-kush is stored and then turned into sauce for porridge in later season (ibid).

Sour milk 'roob' substitutes are made from oil-bearing seeds in a manner analogous to the use of soybeans to give dairy product analogs, roob-heb is made from the seeds of the watermelon and roob-fui is made from peanuts [14]. In either case the seeds are pounded into a paste that is allowed to undergo a souring fermentation, when mixed with water and turned into sauce the product has the color (off white) and taste (sour) of the sour milk sauce called muiah-roob [ibid]. A related product is um-zummatah, obtained by the souring fermentation of watermelon juice [ibid].

Porridge is made from a number of cereal substitute foods such as watermelon (Citrullus lanatus) seeds and wild cereal Cenchrus biflorus (known locally as haskaneit). Watermelon seeds are first drying and then grinding and these dried seeds using to make porridge (called locally bajbaji), dried

watermelon seeds can be preserved for years [20]. People in Darfur and Kordofan regions regularly consume the haskaneit, either eaten raw or prepared into acida and kisra. The Cenchrus biflorus seed is pin-head sized and normally remains within the husk; threshing to release it is not easy, but the seed is considered a famine-food elsewhere in Nigeria, Ghana, Sudan, and India [22]. The haskaneit seed is edible and highly nutritious, its protein, crude fiber and fat contents are high compared to staple foods - sorghum and millet [23]. The seeds of Haskaniet are usually rubbing between two pieces of cloth so as to remove the husks from the seeds. So, obtained seeds are grounded and the flour is consumed as kisra or acida, which is reputed to be delicious [ibid].

In disaster situations Sudan (e.g. conflict-affected areas), mourning dove (Streptopelia decipiens) and red-billed quelea (Quelea quelea) have been identified as sources of emergency food in times of scarcity [24]. The red-billed mourning dove represent important source of protein. In most African countries at least part of the populations have traditionally exploited quelea for food, these birds may be smoked or dried in the sun to preserve them [25].

Wekab (a starchy ash) is alkaline material are produced from sugar cane stalks, after several operations, a burning cane fermentation and distillation drying these stages produces material use to enhance the flavor. Stew (wekab or mulah labn - meaning milk stew) is made by milk, crushed peas, chopped onions, peanut butter dried okra, salt and spices, adding flavoring (wekab) make this stew a more flavorful product (see Fig. 6). Wekab stew is very popular in central Sudan (sugar-cane areas) usually served with acida or kisra



Fig. 6. Wekab (a starchy ash).

VI. UNIQUE INDIGENOUS FOODS

A. Insects as a Food Source

Food and Agriculture Organization (FAO)² presents edible insects as a viable replacement for meat in the event of a food shortage over the next century because insects

² FAO 2013. Edible insects: Future prospects for food and feed security. Food and Agriculture Organization (FAO), Rome, Forestry Paper 171. http://www.fao.org/docrep/018/i3253e/i3253e.pdf

contain high quality protein, vitamins, minerals and amino acids for humans; in addition, insects have a high food conversion rate. In many cases people started eating the insects out of necessity, such as in conflict areas. Eating termites is a way of life in western Sudan. Some ethnic groups in the western parts of Sudan eat termites and locusts. During famines (1984-1985) millions of people around the world observed women in Darfur collect termites as famine foods.

Insects form part of the human diet in many countries and regions of the world and approximately 1,900 insect species are eaten worldwide, mainly in developing countries [26]. Insects become important sources of food (protein) for people in some areas of Sudan. Group of insects commonly called grasshoppers such as caterpillars, locusts, and desert locusts are a part of the normal diet during their season in some parts of Sudan. Edible insects have adequate protein quantity and quality and high content of unsaturated fatty acids and minerals like iron and zinc, and they can be produced with less environmental impact than livestock [27].

The desert locust (scientifically known as Schistocerca gregaria) outbreaks often occurred in very high densities in some parts of Sudan and are usually caused damage to crops. As indicated by key informants they catching locusts during their season by making circle of fire around a hole within which the locusts fall, and then be collected in large quantity. Locusts are eaten ether raw (only after removing wings, legs and head) or can be cooked (i.e. frying, boiling, smoking, salting, and so forth). Locusts are usually cooked in salted water that mixed with a little oil for half an hour and eaten immediately or dried in the sun (see Fig. 7). The locusts are traded in some local markets in Khartoum. In some rural Sudan people are usually cooked the locusts in soups or stews. Some studies indicated that desert locust is a nutritious food source for both humans and animals. The locust has a rich nutritional composition in terms of proteins, fatty acids and minerals [28]. Locusts are excellent sources of protein and are low in fat and are rich in essential nutrients - minerals (calcium and phosphorus) and vitamins such as Vitamin B2 [29]. A challenge to insects becoming an important protein source for humans and animals is the development of cost-effective, automated mass-rearing facilities that produce stable, reliable, and safe products [26].

Locusts - boiled in salted water and then dried





Fig. 7. Locusts.

B. The Wild Species as a food Source

Wild foods species are naturally available and provide sufficient affordable, nutritious food due to their availability

and affordability. They are usually low cost production and their fruits are ready-to-eat foods. Fruits of the wild woody trees have excellent storage capacity. The wild species widely grown in the rural Sudan and their products represent foods ingredients integrated into people daily diets and also substitute for other food items during food shortages [20]. The collection and consumption of wild edible plants has been 'a way of life' to supplement dietary requirements for many rural populations throughout the world [30]. Wild edible plants are known to make important contributions to food baskets and livelihoods in the smallholder and subsistence farming communities of sub-Saharan Africa [31] including Sudan. Some wild edible species are vital sources of food and income for many rural people. During agricultural crops off-seasons wild food play a crucial role in securing food and providing a substitution source of income to the rural households [32]. In conflicts-affected areas and during famines wild products play a significant role as survival food. In Gogrial County in Southern Sudan, for example, while the contribution of farming to the overall household livelihood decreased by almost 20% during the war, the contribution of wild foods increased by about 38% [33]. People in rural areas of western Sudan faced with a major crisis of food shortage (famine) in the 1980s; with food scarcity, people collected and consumed roots, wild barriers, and tree bark played a more significant role in individual daily food diets [34].

Some edible weeds such as molokhia (Corchorus olitorius) have become part of the cultural diet of people in different parts of Sudan. Some of agricultural edible weeds are characterized by high nutritional value and medicinal properties. Some edible wild weeds can be eaten raw, in particular leaves such as Sonchus oleraceus (known locally as moleita) used as fresh salad. Wild green leafy vegetable (Sonchus spp.) are consumed fresh in most rural Sudan. Salt, groundnuts butter, tomato, onion, and oil are usually add to (Sonchus spp.) to enhance its taste. This finding is consistent with study in sub-Saharan Africa which has demonstrated that traditional leafy vegetables contribute significantly to household food security and add variety to cereal-based staple diets [35].

Wild woody trees such as Balanites aegyptiaca Del. (Arabic name Heglig, English name desert dates) its fruits locally known as 'lalob' are dried but sweet and edible (see Fig. 8). Fruits "lalob" are usually consumed raw as they are picked. Grewia tenax (its fruits known as guddaim) is wild plant species in particularly in western Sudan. Fruits (guddaim) are small berries may be eaten ripe or left to dry. A thin porridge called Nesha is prepared by boiling millet flour and fruit pulp of guddaim and adding custard to the mixture [36]. Fruits 'called locally 'gongolaise' Adansonia digitata tree (called locally tabaldi) are either eaten raw or cooked (see Fig. 9). Most of the wild plant fruits are dry and have very good storage capacity like 'aradaib' (Tamarindus indica), 'guddaim' (Grewia tenax), 'gongolaise' (Adansonia digitata), 'lalob' (Balanites aegyptiaca) and 'nabaq' (Ziziphus spina-christi). They are often stored for several months during the dry season. Delicious drinks are prepared in different ways from the fruit pulp of these wild trees such as aradaib, guddaim, and gongolaise in different parts of Sudan.



Fig. 8. The fruit of Balanites aegyptiaca (locally known as lalob).



Fig. 9. Tabaldi tree (Adansonia digitata) and its fruits gongolaise.

Boscia senegalensis (makhait) is well known as famine foods, particularly during famine period in Darfur. Some of wild products are not used as foods in their unprocessed state because they contain toxic or anti-nutritional factors. Such wild products are usually need special treatment to be edible. For instance, people in Darfur with their knowledge were able to process the mukheit (shrub tree with wild berries) and make it edible [9]. Mukheit is highly toxic when raw and needs to be soaked in water for days before it is edible [37]. The mukheit fruit is soaked in water for several days and after draining the bitter water, fresh water is usually added, this process repeatedly (add fresh water and drain it) until the berries becomes tasteless, or in other words the poison is leached [ibid]. Then the berries are ground and cooked as porridge. Therefore, during the famine time (1984-1985), mukheit became the staple food and replaced the 'sorghum grains', which had become a luxury [37].

VII. TRADITIONAL (SUSTAINABLE) PROCESSING METHODS

A. Fermentations

Fermentation is a natural process used for processing cereals, animal, and wild products in rural Sudan to preserve these products for years. Lactic acid fermentation of cereals, meat, milk, bones, fish, vegetables, and wild plants are carried out in different parts of Sudan. Fermentation allows food to be stored for long periods of time without refrigeration. Fermented foods and beverages are estimated to make up approximately one-third of the human diet [38]. Traditional fermentation serves many purposes: alter the texture of foods, enhance the digestibility of a food, preserve foods by production of acids, or produce subtle flavors and aromas which increase the quality and value of raw materials [39]. In Sudan fermentation is the most popular way of improving food flavor, this made fermented foods one of the main dietary items of the daily meals. Sherrmot (fermented meat) doddery (fermented bone), miriss (fermented fat) provide valuable protein sources, fat nutrients and interesting flavors. The Sudanese people seem to ferment just about anything edible or barely edible, in addition to the conventional raw materials, such as cereals, milk, fish, meat, fruit and honey, and unorthodox materials such as bones, hides, hooves, caterpillars, locusts, and cow urine are also fermented as delicacies and/or pounded powders to use as condiments for sauces [14]. Nonetheless, fermented food products have been and will continue to be significant in the Sudanese diets.

1. Fermented Cereals

Kisra is a type of very thin flat bread made from fermented sorghum or pearl millet flour. The sorghum or millet flour is usually mixed with water and kneaded by hand to form dough, then the leaven is added which is either small amount of old dough or roob (home-made curdled milk) and the mixture is left to ferment at ambient temperature (fermentation time varies from 12 to 20 hours depending on the temperature 25°C to 45°C). Then sourdough mixed with a little wheat and water before baking. A small amount of the fermented mixture is spread into a thin sheet over a hot steel plate (approximately 150°C to 160°C) for less than a minute and is then lifted. Several sheets of kisra are folded together and served with hot sauces (see Fig. 10). It commonly practicing that piece of dough is kept to ferment the next batch (known as khmar). Depending on the area, acida is stiff porridge made from fermented sorghum flour (in north, central and east parts of Sudan) and fermented pearl millet (in western Sudan), or mixture. It may be thick (in western Sudan) or soft (in the rest of Sudan). For porridge preparation, the fermented flour is usually added to boiling salty water in a pot and the mixture is then stirred for about 30 minutes. Kisra and acida are normally served with a variety of hot sauces and stews (e.g. dried okra mixed with dried meat and onions) poured over kisra or acida and it is eaten with fingers.

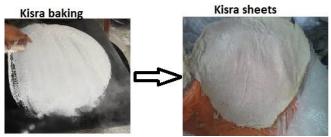


Fig. 10. Kisra (fermented sorghum).

Most wheat is grown in the north of Sudan. The most indigenous wheat food in is dates gorasa. Dates gorasa (thick, soft, medium-size pancake bread mixed with dates) is made from naturally fermented wheat dough supplemented with dates and then mixed with spices and usually baked in a circular shape for approximately 2-3 min on a hot plate in north Sudan particularly and it can be stored unrefrigerated for more than two weeks. Dates gorasa are special food for travelers to take on his/her long journey from north Sudan to Khartoum or other parts of Sudan.

2. Fermented Dairy

Milk is a valuable nutritious food that has a short shelflife. The most widespread indigenous dairy products of rural Sudan are roob, cheese and mish (spiced traditional yoghurt) which are usually produced during the rainy season when cows are producing plenty of milk. Roob is made from surplus unheated milk by inoculating with starter culture from the fermentation of the previous day. After coagulation, the curd is churned early in the morning either by sîin (made of tanned goat skin) or by bokhsa (a gourd made from dried fruit of the plant Lagenaria peucantha) [40]. During this process small quantities of cold water are added once in a while to speed up the butter production [12]. The butter (known as forsa) removed by hand to a separate pot and heated to give traditional gee called locally samin which can be stored for several months. The remaining sour milk after butter removal is roob. Mish is another traditional fermented milk product, made by inoculating fresh milk with a small quantity of soured roob then spices like black cumin, fenugreek, garlic and black pepper are added and allowed for lengthening fermentation. Mish can be preserved and consumed for long time after it has been made.

Sudan has the second largest number of camels in Africa which are mostly owned by the nomads who traditionally depend on camel products as source of foods [41]. The longer lactation period and higher lactation milk yield made camel suitable to the nomadic way of life. In most pastoral societies, milk and its products are consumed daily and is the main contributor to the camel herders' nutrition. Because of their unique physiology, camels are capable to handle dehydration for more than a month [42]. Camel herders make a type of traditional sour milk called gariss (literally means sour) and cheese called kush-kush represent important source of food for the nomadic people in dry-land Sudan. Fresh milk (unheated), gariss and kush-kush represent survival foods for the camel herders and their family in the desert harsh environment. Although drinking fresh unprocessed camel milk is very rare among nomads, because they believe that gariss is much healthier than fresh milk [ibid]. Gariss is a type of sour milk made without prior heat treatment and is subjected to natural lactic acid fermentation until it turns sour. Gariss is fermented camel milk. The raw camel milk that has undergone fermentation is usually fed in two large leather bags made of tanned goat skin (Si'in) hung on the saddle of a burden camel in order to create balance, these bags are usually covered or entrenched in green grass or dry grass moistened with water, all held in thick twisted palm leaf rope nets, the spontaneous fermentation was initiated by adding few seeds of black cumin (Nigellica sativa) and an onion bulb [43]. Fermentation of gariss takes place while the camels are on move and due to the inherent jerk in the camel's walk; the milk in the bags is gently shaken during fermentation [44]. If a quantity of fermented milk (gariss) was consumed the same quantity will be replaced with fresh camel milk and this process continues for months [10].

3. Fermented Fish

Although fermented fish products are not very common and fish is generally smoked or sun-dried, however fermented fish products are commonly practicing in Sudan. The traditional commonly practiced fish preservation techniques are produced by fermentation and drying without salting or fermentation with salting but without drying [20]. Most of indigenous fermented fish products are usually prepared from freshwater Nile fish and made from the whole small fishes. Fessiekh is made mainly from two common Nile fish, namely, Kawara (Alestes spp) and kass (Hydrocyonus spp) [43]. Fessiekh is a type of wet-salted fermented fishery product, while and maluha/terkeen are salted fermented sauce and both are common in northern and central Sudan. Both can be kept in airtight containers or glass jars for later consumption. In the making of fermented fish, known concentrations of salt are added to promote degradation of proteins and retard the growth of undesirable, putrefactive microorganisms, this allows desirable, NaCltolerant (halo-tolerant), fermentative species such as lactic acid bacteria to grow [43]. Fessiekh and maluha/terkeen stews are made by salted fermented fish, dried or fresh onions, tomatoes sauce, spices and peanut butter and usually served with traditional thick-pancake bread made of corn and called locally gorasa (in north Sudan) or fermented sorghum/millet acida (in western Sudan). Some of other fish products include kejeik (hard fermented sun-dried fish) popular as indigenous food fish for people in central Sudan (mostly Blue Nile and White Nile) and other parts of Sudan, mindeshi (minced small fish paste, fermented, and may be dried later) used by the people of western Sudan. Fermentation is often combined with salting and/or drying in order to reduce water activity and retard or eliminate the growth of photolytic and putrefying bacteria [45]. A dried black or brown (color depends on the type of fish used). In preparing kejiek, the fish are gutted with or withoutbeheading, and then washed. They are next split longitudinally (from the gills to the tail fin) into several pieces and plaited, salted or dipped into salt solution for three days and the braid, or plait, then dried. The traditional way of suspending kegiek for drying is hanging fish over ropes or tree branches or spreading on mats under the direct sun (see Fig. 11). kegiek has a very strong pungent smell and a variety of stews can be prepared from kegiek after is broken into small pieces or ground to a coarse powder.





Fig. 11. Kejeik (fermented fish).

B. Drying

Drying is one of the easiest and most effective ways to preserve vegetables (leafy greens, onions, beans, okra, and tomatoes). Drying is used to preserve food items in times of abundance for times of scarcity. Dried vegetables are the base ingredients of the variety of sauces and stews that are eaten with acida or kisra. Molokhia is the leaves of Corchorus olitorius commonly known as Nalta jute, tossa jute, and Jew's mallow used as a vegetable. Molokhia can be dried and stored for later use. The Molokhia leaves are stripped from the stalks, washed and then spread over woven mats or aluminum tray to dry in the shade. Dried Molokhia leaves crushed and then can be stored for a long period. Onion, oil, and peas can be added to dried Molokhia and heated to make stew (called um-takshow), but in emergency situation it only need presoaking for an hour or less.

Tomatoes and okra are often sliced into pieces so that they dry thoroughly. Peeling off the skins and then cutting into rings is a popular way to dehydrate and store onions in a cool, dry place that is not in direct sunlight. The cold water is added back, and the dried-onions return to its original shape. Drying vegetable by decreasing the amount of water in the food inhibits deleterious microorganisms from spoiling the food, so the dried ones have shelf life.

It is well known that meats have a short shelf life unless frozen. However, indigenous processing, fermentation, drying and salting have long been practiced and are contributed to increase the storage life of meats. Meat is usually cut in long pieces to permit the equal and simultaneous drying of the whole batches of meat. The meat-strips are salted and smeared with powdered coriander, and then are laid on metal trays or hung on ropes inside the house in a ventilated area to gradually drying for a week or more (locally called shermout). The dried meat-strips are usually taken a brown color and they become too dry for microbial action. This dried meat is usually stored as coarsely or finely grounded shermout for months without getting spoilt. Shermout is made into a variety of stews (with dried okra or with fermented milk). Waste animal products such as musran which is animal small intestines which is fermented and dried, particularly in western Sudan. It is kept at room temperature for days to allow lactic acid fermentation. The fermented musran needs thorough drying (see Fig. 12). Then fermented-dried musran requires proper cooking before consumption.



Fig. 12. Musran (animal small intestines which is fermented and dried).

VIII. NUTRITIONAL VALUE AND POTENTIAL HEALTH BENEFITS OF INDIGENOUS FOODS

Rural people who have access to a sufficient variety of traditional foods are some of the healthiest people. People living in cities frequently consume a diet higher in fat which is less healthy when compared to that of people living in rural areas who follow a more traditional diet [46]. Indigenous foods are both palatable and enjoyable, for example fermented kisra and acida has a sour flavor which is particularly enjoyed. Moreover, indigenous food processing techniques impact the texture, flavors, and edibility of the final products. Nonetheless, indigenous foods have the nutritional values in addition to their potential health benefits.

It is widely agreed that the beneficial effects associated with fermented foods include reduced loss of raw materials, reduced cooking time, improvement of protein quality and carbohydrate digestibility, increased shelf life and microbiological safety of a food and improved bioavailability of micronutrients, general improvement in the texture, taste, aroma and elimination of toxic-nutritional factors [see for example 47]. Lactic acid bacteria increase food palatability and improve the quality of food by increasing the availability of proteins and vitamins and it also confer preservative and detoxifying effects on food [48]. Fermentation processes where growth of selected microorganisms causes an adjustment in the pH of the product, and the inhibition of growth of pathogens and spoilage microorganisms [13].

Indigenous food processing methods like soaking, germination, drying, fermentation, boiling, and roasting, and diet combinations usually reduce the levels of zinc antagonists in the plant diets, thus increasing zinc absorption and bio-availability [49]. Fermented fish products in Sudan are important sources of nourishment, they contain great amount of a high quality protein [42 – see Table 1). 'Feseekh' is a good source of essential fatty acids for human (eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA)), and with same level of DHA/EPA ratio can provide the daily requirement of DHA and EPA as fresh fish [45].

TABLE 1 CHEMICAL COMPOSITION AND PH VALUE OF FASIEKH AND

CONTROL FRESH FISH SAMPLES									
Fasiekh	Moisture	Protein	Fat (%)	Ash (%)	pН				
Sample*	(%)	(%)							
A	77.03a	8.17e	3.47c	11.33e	6.10a				
В	46.34c	29.50b	3.63bc	20.53c	6.72a				
C	39.59d	33.41a	8.09a	18.91d	6.51a				
D	50.15b	25.40d	1.18d	23.27b	6.67a				
F	39.62d	28.38c	5.22b	26.78a	6.59a				

* $\mathbf{A} \equiv \text{Fresh fish samples (unsalted)}$; $\mathbf{B} \equiv \text{Dry salted Fasiekh samples (fresh)}$. $C \equiv Paste Fasiekh samples; D \equiv Fasiekh samples in salted water (Routo$

 $\mathbf{F} \equiv \text{Fasiekh samples packed in tin gallon container.}$

The table adapted from reference [43].

Fermentation has been shown to improve the nutritional value and digestibility of sorghum and millet which constitute the main staple diet of most rural Sudan as indicated by analysis of the nutrient contents of the traditional fermented food items kisra and acida. Baking of fermented dough (kisra) increased the total polyphenol content by 55% and 117% of fermented sorghum cultivar at 8 and 32 hours fermentation time [50]. kisra provides most of the dietary proteins and energy especially the rural areas of Sudan; the average values for the composition of kisra as reported by many investigators are: 50% moisture, 30-40% carbohydrates, 12% protein, 2% crude fiber and 1.5% ash [51]. For kisra production, fermentation of sorghum is completed in about 12-19 hour by which time the pH drops from about 6.0 to less than 4.0 [52].

Fermented milks have been claimed by some research findings for being more nutritious and health promoting than fresh milk [53]. The analyses Kejeik samples (fermented fish) indicated is a safe food with high nutritive value [54 – Table 2]. kejeik contain higher contents of protein, fat, fiber ash, moisture and carbohydrate and appreciable amounts of macro-minerals and the calcium and Kejeik samples free from toxic metals such as mercury, arsenic and cadmium [54]. The food made from sprouting grains (a stage in fermentation) is found useful in treating diarrhea and other illnesses [16]. Hulu-mur fermented drink consumed as beverage during Ramadan contents 6.1% moisture, 3.7% lactic acid, 14.26% protein, 3.45% ash, 31% sugar, with lactic acid, ethanol, and acetic acid as major products [16]. Fermented dairy products such as roob, mish and sour milk are protein-rich milk products [54]. Kawal has high protein content, is reputed to have a highly appetite-stimulating effect and aphrodisiac properties [16]. Study by references [55] indicates that modification of the karkade seed proteins by traditional fermentation (furundu) significantly increased the in vitro protein digestibility - reached the maximum value (82.7%) – and it imparts superiority to emulsification properties.

TABLE 2 CHEMICAL COMPOSITION OF KEJEIK SAMPLES

Kejeik type	Moisture (%)	Ash %	Fat (%)	Fiber (%)	Protein (%)	Carbo- (%)
Ijl	5.9±0.13	5.8±0.31	9.1±0.47	0.6 ± 0.01	78.1±1.68	1.61±1.17
Garmut	5.4 ± 0.23	10.4 ± 0.55	16.1 ± 0.59	1.3 ± 0.81	67.0 ± 0.82	0.66 ± 0.61
Nawk	6.4 ± 0.04	6.3 ± 0.54	11.6 ± 0.20	0.6 ± 0.25	75.0 ± 0.37	0.59±0.18

The table adapted from references [54]

Some wild edible species have a higher nutritional value than domesticated crops. Chemical analyses revealed that wild edible plants (makhait, nabaq guddaim, lalob and wild haskaneit grass) are richer in energy, protein, unsaturated fatty acids, crude fiber and minerals than the staple crops [23]. Wild vegetables are generally reported to be rich in micronutrients; they also influence the intake of cereal staples, manage hunger and play a central role in household food security for the poorer rural groups [56]. Based on their potential nutritional and medicinal value, edible weeds could contribute in a major way to food security, basic primary health care and balanced diets of rural households and possibly urban households as well [57]. Wild Adansonia digitata fruits contain useful quantities of potassium, phosphorus, zinc and α-Linolenic acid [58]. Although wild Boscia senegalensis (makhait) has a sour taste, it contains about a third of the calories of grain [37]. One hundred grams of mukheit when cooked contain about 70 percent of the energy in the same amount of cooked millet or sorghum [37]. Insects have been well recognized worldwide as nutritious food, since insects provide – proteins (amino acids such as methionine, cysteine, lysine, and threonine), carbohydrate, fats, some minerals (calcium, iron, zinc, phosphorous), and some essential vitamins such as vitamin A, B complex, and C [59].

Microbial analysis of the sorghum before and after fermentation revealed that coli-form bacteria 'E. coli' counts exceeded 2.400 unites per gram (cfu/g) in the raw sorghum flour but the counts were very low in the fermented dough [60]. This might be due to the reduction of pH and accumulation of organic acids in the fermented sorghum flour, to production of certain microbial by products which eliminated these pathogens [ibid]. Fermentation and thermal processing have the potential to improve the antioxidant capacity of kisra prepared from sorghum cultivar and thus contributed significantly to the health benefits associated with sorghum-based foods consumption [50]. Study by references [36] indicated that guddaim fruits contain essential nutrients such as minerals, amino acids, sugars, vitamins and volatile compounds which if properly utilized can improve human nutrition and health.

The leaves of Hibiscus sabdarifa (karkade) contained an appreciable quantity of protein the composition of which was comparable to the World Health Organization (WHO) standard, the mineral content of the leaves of this plant was also exceptionally high; noteworthy was its high zinc content and also contained significant quantities of the two essential fatty acids [58].

When used regularly, lactic acid bacteria fermented foods boost the immune system and strengthen the body in the fight against pathogenic bacterial infections [48]. Sesame cake is rich in protein, calcium, phosphorus and niacin; sesame proteins are rich in sulphur containing amino acids particularly methionine and cysteine [51]. kawal is believed to possess laxative effect, as well as to be beneficial for eyes [cited in 15]. Besides their role in indigenous food preparations, some of wild plants are widely used for medical treatments. Balanites aegyptiaca Del. tree (Heglig) leaves and fruits (lalob) are used traditionally as laxative and anthelmintic in Sudan. It has been experimentally proved that B. aegyptiaca Del possess antioxidant, antimicrobial, anticancer, diuretic, hypocholesterolemic, wound-healing, antiviral, antidiabetic, hepatoprotective, mosquito larvicidal, anti-inflammatory and analgesic, antivenin, anthelmintic, cardioprotective cum antioxidant activity, and antinociceptive properties [61].

IX. ADDRESSING THE CHALLENGES

Question that addressed in this study how the people in rural (also in conflict/post-conflict areas) find practical solutions to the food shortage problems encountered as part of everyday living? An important part of the answer might be indigenous foods play an important role as survival food for rural people, and as stated by reference [9] even in the conflict-affected areas of Darfur region. The traditional foods are critical to the survival and future wellbeing of people in rural and conflict/post-conflict areas as they try to maintain their livelihoods under unfavorable conditions. The research argues that workable and sustainable solutions to food insecurity should take into account local peoples' associated knowledge and cultural practices. This requires a good understanding of deeply-rooted knowledge and practices related to food. Given that the process of indigenous knowledge construction is influenced by experience, prior knowledge, values, beliefs, as well as socio-cultural factors of community life. There remains a need to address fundamental gaps in knowledge to encourage broader uptake of peoples' indigenous foods into policy. This may provide potential windows of opportunity to stability of food supplies for rural people. It may be achieved in part through measures designed to challenge the existing gravity of periods of food shortages. There is lesson being learned from the way of life - through the persistent efforts of rural people who deal with reality on the ground. Lessons were learnt from dealing with food shortages past experiences elsewhere, both positive and negative. There are no short term solutions, but rather long term interventions. Science and technology have to play an important role in improving the quality of the end-products.

Most of the traditional foods (the food of survival) are still unique to the Sudan. Based on their knowledge of the local situation, they are processed locally available resources (agriculture, animal, wild plants, insects) through traditional methods into food products that meet their dietary needs and food preference with a higher nutritive value compared to the raw material, a better taste and has a longer shelf life. In effect, traditional foods would comprise the successful ways by which people in rural and postconflict areas deal with their environments and surroundings to solve everyday food shortages. It is such a knowledge base which associated with cultural identity that has helped those communities sustains their livelihood through these survival foods.

The study argues that the available data on food security are likely to provide an underestimation of the contribution of indigenous foods to total food security of Sudan. The indigenous foods need be recognized as a 'foods for survival'. Food security policies and interventions strategies often ignore the potential contributions from Indigenous foods, hence their failures in addressing the food insecurity problems and challenges in rural and post-conflict areas. Generally, indigenous foods, although not generalizable as such, can be applied when designing strategies to address food insecurity problems in rural and post-conflict areas Sudan. State efforts need to be directed to strengthen the indigenous processing techniques adopted by rural.

There is a need for national policies to support survival foods that would ensure safety, quality, and efficacy of its practices. Food security efforts focus on the need for an adequate physical availability of food supplies, food access and adequate utilization of food. This study raises the issue of what kind of interventions can be a potentially effective way to achieve both food security and protect traditional food legacy. Arguably, pro-poor policy processes are those that allow poor people to be directly involved in the policy process, or that by their nature and structure lead to pro-poor outcomes. Pro-poor oriented policies are basically to stimulate economic growth for the benefit of poor people. Government actually began to implement pro-poor programs, such as Microfinance and Microcredit Programs. However, the microfinance system needs to be innovative in terms of creating solutions that fit the needs of local people to build their resilience to food insecurity. The principle of ownership should be part of the planning, implementation, and evaluation of monitoring pro-poor programs interventions. But ownership also implies more respect for the autonomy and priorities of the local people. It means accepting that local people are much more than just implementers of policy designed by government.

The Indigenous foods are relying on practical experiences and observations handed down from generation to generation. Indigenous foods can make an important contribution to the sustainable development by the ways and means in which they contribute to secure household food. The best option for support is to involve those who have the most experience to understand the practical basis of indigenous food. As a nationally significant project, the promotion of indigenous foods should receive high-profile political attention. Planners need to create an enabling environment for indigenous foods to achieve the best results. Human capital can be developed through specific investments in education and raising-awareness programs, while social capital can be enhanced through programs that support community development and provision of needed infrastructure.

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