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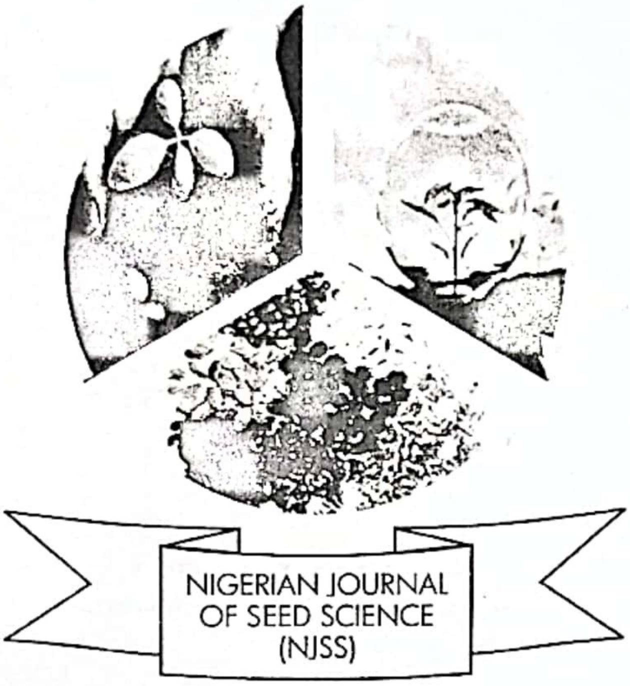

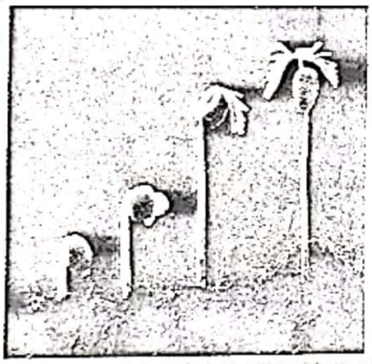

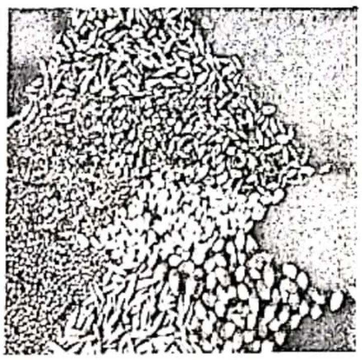

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The Quality of Seeds of Different Cultivars of Pepper (*Capsicum annuum Linn.*) Processed by Different Methods

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Abstract
Most pepper farmers especially in developing countries rely more on seeds of previous years' harvest to raise subsequent crops and such seeds are normally processed similarly irrespective of cultivar differences. Information is scanty on seed quality variability that may exist among the various cultivars and processing methods. It has been observed that improper processing (seed extraction and drying) methods lead to low and slow seed germination. It is therefore, necessary to determine the quality response of different cultivars to seed extraction and drying methods. An investigation was conducted at the Federal University of Technology, Minna, to determine the effect of two extraction methods (extraction of seeds from wet ripe fruits followed by drying (E1) and extraction of seeds from dry fruits (E2) and two drying methods (in the sun-D1 and in the shade-D2) on seed quality of six pepper (*Capsicum annuum* L.) cultivars. The study was a 2 X 2 X 6 factorial experiment conducted using the Completely Randomised Design. Seeds of cultivar 'Shombo-Dan Guru' generally recorded significantly higher germination percentage and germination index (GI) and maintained viability for a longer period compared to the other cultivars; poor performances were recorded in seeds of cultivar "Tatashe-Dan Kano. Air-drying resulted in significantly higher and faster germination than sun-drying all through the storage period. The study revealed that longevity was better maintained when seeds of different pepper cultivars were extracted from fresh fruit and afterwards air-dried. Significant interaction effects of cultivar, extraction and seed drying methods were also recorded. Freshly processed seeds exhibited some dormancy which was lost with ageing. It can therefore, be concluded from this study that, except in cv. SB-DGU, it is not advisable to extract seed from sun-dried pepper fruits. Seeds should preferably be extracted from red-ripe freshly harvested fruits followed by air-drying.

Keywords: Cultivar, seed extraction, drying, germination percentage, germination index and longevity.

Introduction
Capsicum is a genus of plants under the family of Solanaceae. Its members have varieties of names according to their location and type with the most familiar being chilli, bell, red, green or just called pepper (Faustino *et al.*, 2007).They are extremely popular for the huge content of vitamin C and total soluble phenolics higher than other vegetables commonly recognized as a source of these substances (Marinova *et al.*, 2005; Anil Kumar *et al.*, 2009). Chilies are important vegetable crops and used world-wide for flavour, aroma and to add colour to foods (Zhuang *et al.*, 2012). Production of the crop in Nigeria has been reported to be very profitable (Idowu-Agida *et al.*, 2010; Sanusi and Ayinde, 2013). In addition, engagement in the production of the pepper helps in job creation, poverty alleviation and food security (Mohammed

et al., 2015). Nigeria ranks 8th and 14th in the world in fresh and dry pepper fruit production, respectively (FAO, 2015).

The demand for high quality seeds has grown substantially in recent years given the importance of the pepper in man's diet. As it is usually the case with low-income farmers, the result from a study conducted by Sanusi and Ayinde (2013) in Ogun State, Nigeria identified inadequate availability of high quality pepper seeds as one of the major constraints to the production of the crop among the sampled farmers.

Seed quality may vary with genotype and a number of post-harvest factors. Smith (2006) noted that varietal differences in seed viability is one of the factors that affects seed longevity in pea and that this distinguishing behaviour of a variety could be attributed to genotypic differences. According to Smith (2006), loss of seed viability differed from one species to another and even among varieties of the same species. Likewise, K'Opondo and Francis (2011) observed that morpho-types of spider-plant differed in germination; suggestions were made that it may be due to the fact that some seed species are prone to faster deterioration which subsequently leads to low performance of such cultivars. Processing technologies are also known to influence seed quality. There seems to be no specific extraction methods for pepper seeds. Sukprakan *et al.* (2005) suggested that pepper seed may be extracted from fresh fruits that have been dried in the sun for few days. McDonald (2014) however, suggested the extraction of seeds from pulped fresh fruits which allows for the separation of good and bad seeds. The moisture content of pepper seeds extracted from fresh fruits is about 30-40% which must be lowered to safe level (Hinje *et al.*, 2007). To do this, attention should be paid to the rate and extent of post-harvest drying. Methods such as shade, sun, vacuum, freeze and refrigeration drying were listed by Ellis and Roberts (1991). Nassari *et al.* (2014) recommended the use of drying chambers and seed dryers. Sophisticated facilities may not be accessible to most resource-poor farmers. The potentials of low cost methods of drying seeds have also been demonstrated by Probert (2003), Muthoka (2003) and Vodouhe *et al.* (2008). Obviously, the low-input methods of sun-and shade-(air) drying will be generally preferred by resource-poor farmers of developing countries who constitute the greatest provider of seeds to fellow farmers. Thomson *et al.* (1998) however, cautioned that high temperature and ultraviolet radiation from the sun during drying may result in poor quality seeds. Just as rapid drying is deleterious, slow drying may also lead to seed infection by bacteria and fungi (Thomson *et al.*,1998).

The objective of this study was therefore, to determine the effects of different seed extraction and drying methods on the quality of some cultivars of *C. annuum* using percentage germination, germination index (GI) and longevity as indices.

Materials and Methods

The experiment was conducted at the Federal University of Technology, Gidan-Kwano Campus, Minna (latitude 9'22°N and longitude 6'15°E), Nigeria. Red ripe fruits of six cultivars of pepper namely, 'Rodo' Dan Sokoto (RD-DSK), 'Rodo' Dan Brini-Gwari (RD-DBG), 'Tatashe' Dan Kano (TS-DKA), 'Tatashe' Dan Kaduna (TS-DKD), 'Shombo' Dan Sokoto (SB-DSK), 'Shombo' Dan Guru (SB-DGU) were used. Fruits of cultivars were divided into four lots with each lot processed differently. Fruits of the first lot of each cultivar were cut open and seeds extracted from them were washed and then sundried. Seeds extracted from the second lot of each cultivar were also washed but dried on the bench under ambient conditions in the laboratory (air-drying). The fruits of the third lot were kept intact and sundried while the fruits of the fourth lot were also kept intact but air-dried. Seed moisture content was determined immediately after extraction (0 week) and at 2, 3 and 4 weeks after drying using the oven-drying method described by ISTA (2005) and the percentage moisture content was calculated on wet weight basis.

Following four weeks of drying, samples of seeds of each of the 24 treatment combinations were spread in open plastic plates and then stored in an incubator at 35°C and relative humidity of about 80% for eight weeks to determine longevity. Samples were drawn for germination test prior to storage and at two weeks intervals after wards for 8 weeks.

To conduct germination test, 50 seeds were counted from each treatment combination and placed on two layers of distilled water-moistened filter paper placed in plastic Petri-dishes and incubated at 30°C. Germination count was recorded daily for a period of 28 days and germination percentage and germination index were subsequently determined.

Germination percentage (GP) was calculated thus:

GP = Ng / Nt × 100 (Kader, 2005). Where, Ng is total number of germinated seeds and Nt is total number of evaluated seeds.

The germination index (GI) was also calculated based on the relationship developed by Reddy *et al.* (1985) thus:

$$GI = (28 \times n1) + (26 \times n2) + \ldots\ldots\ldots + (2 \times n28)$$

Where n1, n2……., n28 are the number of seeds that germinated on the first, second and subsequent days until the 28th day, respectively; 28, 26,………., and 2 are the weights given to the number of seeds that germinated on the first, second and subsequent days, respectively.

In this study, germination counts were taken for 28 days. All the data collected were subjected to analysis of variance (ANOVA) based on completely randomized design (CRD) using SAS Statistical Package 9.2. Means were separated using the Student-Newman-Keuls (SNK) test. Data in percentages were transformed to arcsin values before statistical analysis.

Results

Figure 1 shows that when seeds were extracted from fresh fruits, significantly higher moisture content (27.8%) was recorded for SB-DSK compared with other cultivars except TS-DKD prior to drying while the moisture content of RD-DBG was significantly lower (16.3%) than those of the other cultivars. Seed moisture

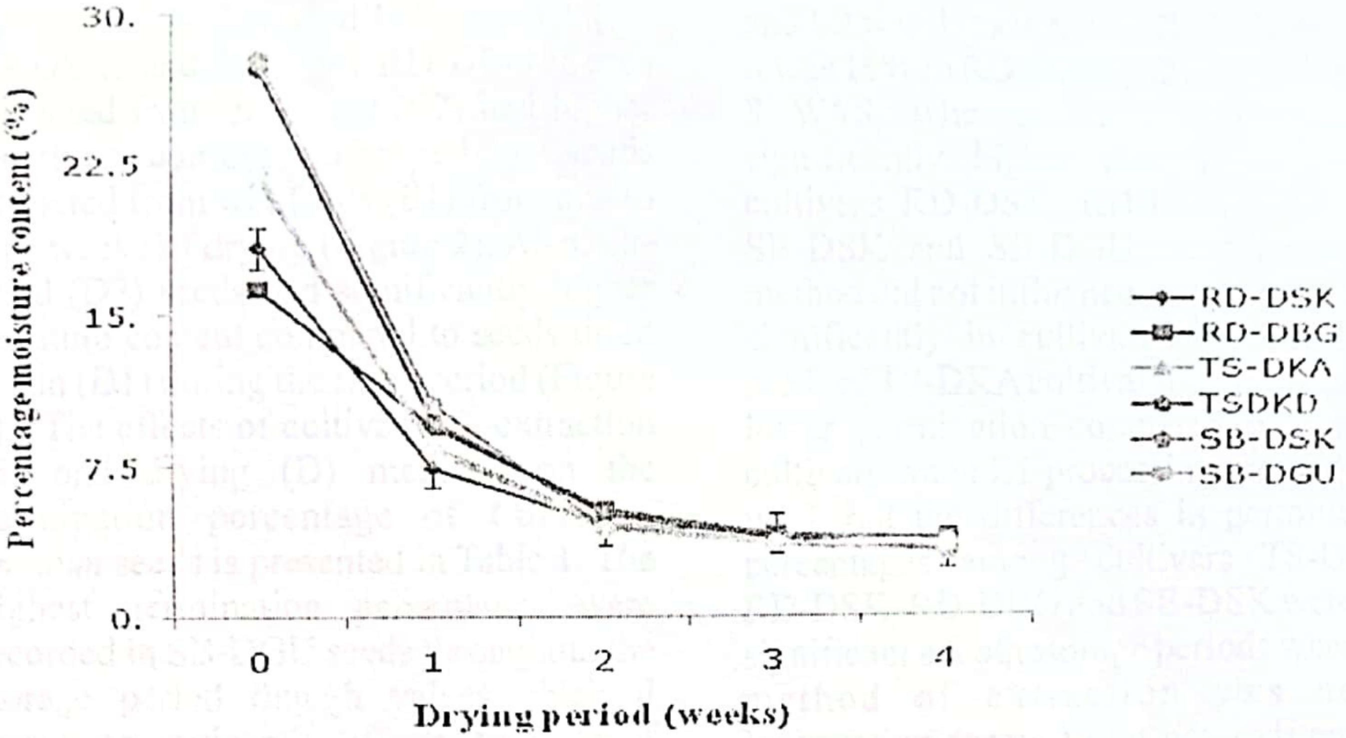

Figure 1. Percentage moisture content of seeds of six pepper cultivars following drying period.
I. = LSD bar, indicating significant differences amongst the cultivars at $p<0.05$.

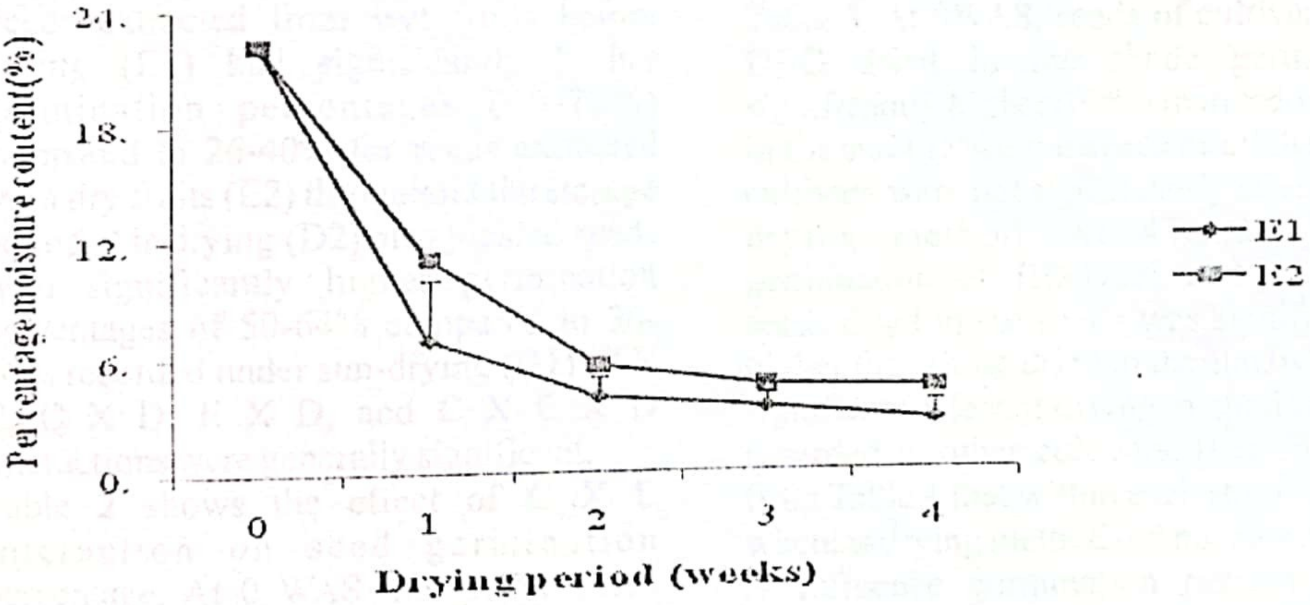

Figure 2. Percentage moisture content of dried seed after wet (E1) and dry (E2) fruits extraction over four weeks.
I.SD bar, indicating significant differences between extraction methods at $p< 0.05$.

content (MC) of all cultivars declined with drying time and with variability among cultivars. At four weeks when drying was terminated, MC ranged between 3.1 (for SB-DSK) and 3.8% for RD-DBG. Seeds extracted from dry fruits (E2) had higher moisture content compared to seeds extracted from wet fruits (E1) from one to four weeks of drying (Figure 2). Also, air-dried (D2) seeds had significantly higher moisture content compared to seeds dried in sun (D1) during the same period (Figure 3). The effects of cultivar (C), extraction (E) and drying (D) methods on the germination percentage of *Capsicum annuum* seeds is presented in Table 1. The highest germination percentages were recorded in SB-DGU seeds throughout the storage period though values obtained were not significantly different from that of SB-DSK at 0 WAS. Seeds of TS-DKA recorded significantly lower germination percentages compared to all other genotypes all through the storage period. Seeds extracted from wet fruits before drying (E1) had significantly higher germination percentages (60-73%) compared to 26-40% for seeds extracted from dry fruits (E2) throughout the storage period. Air-drying (D2) also yielded seeds with significantly higher germination percentages of 50-64% compared to 36-50% recorded under sun-drying (D1). C X E, C X D, E X D, and C X E X D interactions were generally significant.

Table 2 shows the effect of C X E interaction on seed germination percentage. At 0 WAS though E1 seeds germinated significantly higher than E2 seeds irrespective of cultivar, the magnitude of the difference between drying methods varied among cultivars. For example, the difference between E1 and E2 was 42% in SB-DGU (C5) whereas it was 19% in RD-DBG (C2). At both 4 and 8 WAS, whereas E1 seed germinated significantly higher than E2 seeds in cultivars RD-DSK, RD-DBG, TS-DKD, SB-DSK and SB-DGU, seed extraction method did not influence germination level significantly in cultivar TS-DKA. Also, seeds of TS-DKA cultivar had significantly lower germination compared with other cultivars when E1 processing method was used, but the differences in germination percentages among cultivars TS-DKA, RD-DSK, RD-DBG and SB-DSK were not significant at both storage periods when E2 method of extraction was used. Information seems to be non-existent on the specific extraction method that should preferably be adopted for pepper. C X D interaction effect on seed germination percentage at 0, 4 and 8WAS is shown in Table 3. At 0WAS, seeds of cultivar RD-DBG dried in the shade germinated significantly higher (62%) than seeds dried in the sun (35%); the seeds of all the other cultivars were not significantly affected by drying method. At 4 and 8WAS, germination of RD-DSK and TS-DKA seeds dried in the shade was significantly higher than those dried in the sun, whereas significant effect of drying method was not recorded in other cultivars. It is apparent from Table 4 that within each storage time, whereas drying method did not significantly influence germination percentage of seeds extracted from fresh fruits (E1), air-drying (D) resulted in significantly higher

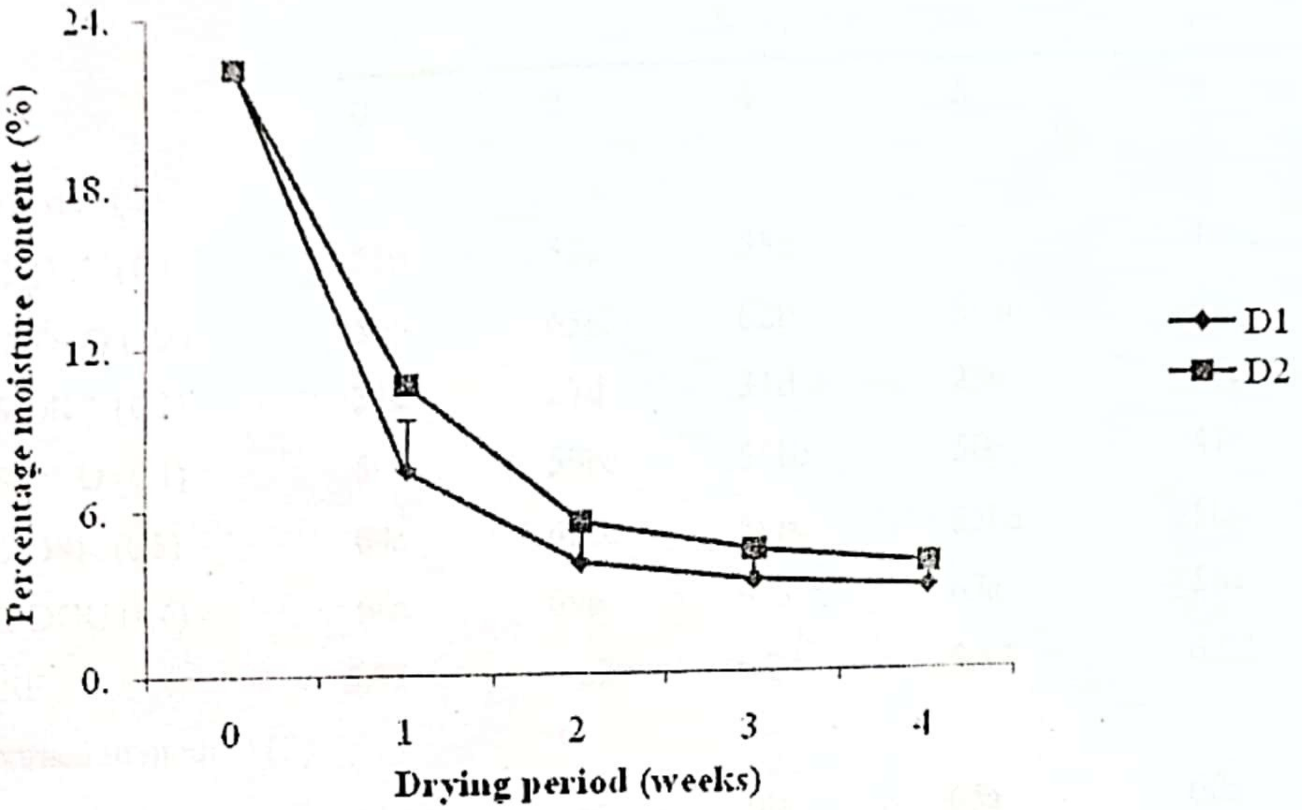

Figure 3. Percentage moisture content of seed that were sun-dried (D1) or air-dried (D2) for the durations indicated.
LSD bar, indicating significant differences between drying methods at $p < 0.05$.

germination percentages than sun-drying (DT) in seeds extracted from dry fruits (E2). Table 5 shows significant variations in the responses of different cultivars to extraction and drying method combinations. Seeds of cultivars RD-DSK (C1), RD-DBG (C2), TS-DKD (C4) and SB-DSK (C5) extracted from wet fruits before drying in the sun or shade and those extracted from air dried fruits generally had similarly higher germination percentages than those from sun-dried fruits. In TS-DKA (C3), seed extracted from dry fruits germinated significantly higher than those of other treatment combinations as from 2 WAS. Drying method did not significantly affect seeds of SB-DGU (C6) extracted from wet fruits. Seeds of the same cultivar extracted from sun-dried fruits germinated significantly higher than those from shade-dried fruits. The Table shows further that in few cases, at the tail end of storage, sun-drying of seeds following extraction from wet fruits resulted in significantly lower germination percentages than in air-dried seeds. It is also evident from the Table that there were increases in germination percentages of some treatment combinations especially within the first two weeks of storage with a general decline at about four to six weeks of storage.

SB-DGU seeds recorded the highest germination index (GI) value throughout

Table 1: Effects of cultivar, drying method and extraction method on germination percentage of *Capsicum annuum* seeds.

	Storage period (weeks)				
	0	2	4	6	8
Cultivars (C)					
RD-DSK (C1)	55b	58c	55c	50c	44bc
RD-DBG (C2)	56b	65ab	62b	59ab	49b
TS-DKA (C3)	31c	27d	31d	23d	17d
TS-DKD (C4)	56b	59bc	55bc	50c	41c
SB-DSK (C5)	64a	63bc	59bc	55bc	50b
SB-DGU (C6)	66a	69a	69a	63a	58a
± SE	5.35	6.22	6.74	5.85	6.02
Extraction method (E)					
Wet Fruit (E1)	69a	73a	70a	65a	60a
Dry Fruit (E2)	40b	40b	40b	35b	26b
± SE	3.44	3.95	3.97	3.66	3.82
Drying method (D)					
Sun (D1)	50b	50b	47b	42b	36b
Air(D2)	59a	64a	63a	58a	50a
± SE	2.74	3.31	3.57	3.19	3.03
Interaction					
C X D	*	*	*	*	*
C X E	*	*	*	*	*
E X D	*	*	*	*	NS
C X D XE	*	*	*	*	*

Values followed by same letter under each factor and storage period are not significantly different (p=0.05).
*=significant; NS=not significant

Table 2: Interaction effect of cultivar and extraction methods (wet fruit-E1 and dry fruit-E2) on germination percentage of *Capsicum annuum* seeds at 0-8 weeks of storage (WAS).

Cultivar X Extraction	Storage period (weeks)				
	0	2	4	6	8
C1 E1	72bc	77a	75a	70a	64a
C1E2	37f	39bcd	35cd	30cd	24c
C2 E1	65cd	80a	78a	73a	67a
C2 E2	48ef	49b	45bc	45b	31bc
C3 E1	44ef	26d	24d	20d	17c
C3 E2	18g	28d	38cd	26cd	18c
C4 E1	71b	85a	80a	71a	65a
C4 E2	41f	34cd	30cd	30cd	18c
C5 E1	85a	83a	79a	75a	75a
C5 E2	43ef	42bc	38cd	36bc	25c
C6 E1	79ab	88a	83a	82a	75a
C6 E2	54de	50b	54b	45b	41b

Values followed by the same letter under each storage period are not significantly different (p=0.05).

the storage period except at 0WAS at which the difference between it and SB-DSK were not significant (Table 6). Furthermore, TS-DKA recorded significantly lower GI than any of the other cultivars throughout the storage period. Seeds extracted from wet fruits before drying (E1) had significantly higher GI compared to those extracted from dry fruits (E2) throughout the storage period. Also, air-drying of seeds resulted in significantly higher GI compared to sun-drying.

Table 7 shows the effect of cultivar and extraction method interaction on seed GI. At 0WAS, SB-DSK (C5) seeds that were dried following extraction from wet fruits (E1) recorded the highest GI (875) but the value was not significantly different from those of RD-DSK (C1), TS-DKD (C4) and SB-DGU (C6) seeds that were also extracted from wet fruits. When seeds were extracted from dry fruits (E2), the highest GI was recorded in SB-DGU (497)

Table 3: Interaction effect of cultivar and drying method (sun-drying-D1 and shade-drying-D2) on germination percentage of *Capsicum annuum* seeds at 0-8 weeks of storage (WAS).

	Storage period (weeks)				
Cultivar X Drying	0	2	4	6	8
C1 D1	43cd	34cd	33de	28de	26de
C1 D2	52abc	63a	59abc	56ab	50a
C2 D1	35de	46bc	44bcd	43bc	38abcd
C2, D2	62a	62a	60ab	58a	49a
C3 D1	30e	23d	21e	16e	14e
C3 D2	36de	35cd	44bcd	37cd	31cd
C4 D1	49abc	49ab	44cd	39cd	33bcd
C4 D2	47bd	54ab	52abc	51abc	45abc
C5 D1	53abc	52ab	49abcd	47abc	42abc
C5 D2	55abc	55ab	53abc	50abc	48ab
C6 D1	59ab	62ab	64a	57ab	52a
C6 D2	50abc	55ab	51abc	48abc	47ab

Values followed by the same letter under each storage period are not significantly different (p=0.05).

but the value was similar to those of RD-DSK (C1), TS-DKD (C4) and SB-DSK (C5). Furthermore, the magnitude in the difference between E1 and E2 extraction methods varied between cultivars; the magnitude was highest (468) in SB-DSK (C5) and lowest (250) in TS-DKA. At both 4 and 8WAS, whereas E1 seeds recorded significantly higher GI than E2 seeds in cultivars RD-DSK, RD-DBG, TS-DKD, SB-DSK and SB-DGU, seeds extraction method did not influence GI level significantly in cultivar TS-DKA. Also, whereas seeds of TS-DKA had significantly lower GI compared with other cultivars when the E1 processing method was used, the differences in GI values among cultivars RD-DSK, RD-DBG, TS-DKD and SB-DSK were not significant at 4WAS when E2 method of extraction was used.

Table 8 shows the effect of C X D interaction on seed GI at 0, 2, 4 and 6 WAS. At 0 WAS, cultivar SB-DGU (C6) seeds

Table 4: Interaction effect of extraction method (wet fruits - E1 and dry fruits - E2) and drying methods (sun-D1 and shade-D2) on germination percentage of *Capsicum annuum* seed

	Storage period (weeks)			
Extraction X Drying	0	2	4	6
E1 D1	69a	70a	67a	60ab
E1 D2	69a	76a	73a	70a
E2 D1	32c	29c	27c	24c
E2 D2	48b	52b	53b	46b

Values followed by the same letter under each storage period are not significantly different (p=0.05).

dried in the sun (D1) recorded significantly higher GI (782) than those air-dried (475), while the reverse was the case in RD-DBG (C2). The GI values of the seeds of all the other cultivars were not significantly affected by drying method. At 2-6 WAS, the GI of SB-DGU (C6) seed dried in the sun was significantly higher than in those air-dried, whereas the reverse was the case in RD-DSK (C1), RD-DBG (C2), TS-DKA (C3) and TS-DKD (C4).

Table 9 shows that drying method did not significantly influence GI values of both E1 and E2 seeds at 0 and 4 WAS but the magnitude of the difference between sun (D1) and air-dried (D2) seed was greater in dry fruit (E2) than in the fresh fruit (E1) extraction method. Also, the magnitude of the differences between the two extraction methods varied with drying method at both storage periods. For example, at 0WAS while the difference in GI between E1 and E2 was about 418 in sundried seeds, the difference under shade drying method was 284.

Table 5: Interaction effect of cultivar, extraction (wet-E1; dry-E2) and drying (sun-D1 and shade-D2) methods on germination percentage of *Capsicum annuum* seeds at 0-8 weeks of storage (was).

Accession X Extraction X Drying	Storage period (weeks) 0	2	4	6	8
A1E1D1	78ab	73bcd	70b	62cd	59c-f
A1E1D2	67bcd	82abcd	79ab	79ab	69bcd
A1E2D1	17g	3i	3i	21	1k
A1E2D2	58de	75bcd	67b	57de	48ef
A2E1D1	61cd	77bcd	75ab	69bcd	66bcd
A2E1D2	69bcd	84abcd	82ab	78ab	68bcd
A2E2D1	12g	28fg	22def	25hij	16hij
A2E2D2	85a	71cd	69b	65bcd	46f
A3E1D1	40f	21gh	21def	13jkl	12ijk
A3E1D2	48ef	31fg	28de	27ghi	22ghi
A3E2D1	13g	11hi	17efg	6kl	3jk
A3E2D2	23g	45e	69b	46ef	33g
A4E1D1	74ab	86ab	80ab	65bcd	55def
A4E1D2	68bcd	83abcd	80ab	77ab	76ab
A4E2D1	42f	25g	17efg	18ijk	11ijk
A4E2D2	40f	44e	43c	42f	25ghi
A5E1D1	86a	81a-d	70b	74abc	70bc
A5E1D2	84a	86ab	82ab	76ab	79ab
A5E2D1	39f	40ef	34cd	33fgh	20ghi
A5E2D2	47ef	45e	43c	39fg	31ghi
A6E1D1	77ab	84abc	78ab	79ab	65bcd
A6E1D2	82a	92a	88a	86a	86a
A6E2D1	70bc	70d	82ab	62cd	61cde
A6E2D2	37f	30fg	27de	28ghi	21ghi

Values followed by the same letter under each storage period are not significantly different (p=0.05).

Table 6: Effects of cultivar, drying method and extraction method on the germination index of *Capsicum annuum* seeds.

Cultivar (C)	Storage period (weeks)				
	0	2	4	6	8
RD-DSK (C1)	562c	519c	532c	437b	337d
RD-DBG (C2)	519c	472c	611b	495b	447bc
TS-DKA (C3)	299d	174d	253d	191c	163e
TS-DKD (C4)	572bc	516c	579bc	437b	383cd
SB-DSK (C5)	641a	609b	558bc	586a	505ab
SB-DGU (C6)	628ab	715a	773a	584a	532a
± SE	61.32	67.07	70.51	59.74	59.69
Extraction method (E)					
Wet Fruit (E1)	712a	667a	721a	609a	548a
Dry Fruit (E2)	316b	335b	380b	304b	242b
± SE	29.26	39.28	39.15	32.88	32.67
Drying method (D)					
Sun (D1)	507b	419b	408b	375b	310b
Air (D2)	567a	583a	622a	539a	479a
± SE	38.26	44.56	44.61	37.76	36.97
Interaction					
C x E	*	*	*	*	*
C x D	*	*	*	*	N.S
E x D	*	*	*	N.S	N.S
C x E x D	*	*	*	*	*

Values followed by the same letter under each factor and storage period are not significantly different (p= 0.05).
.= Significant, N.S= Non-significant

Table 7: Interaction effect of cultivar and extraction method (wet fruit-E1 and dry fruit-E2) on germination index of *Capsicum annuum* seeds at 0-8 weeks of storage (WAS).

	Storage period (weeks)				
Cultivar X Extraction	0	2	4	6	8
C1 E1	769ab	700b	768b	612b	487b
C1 E2	365cd	338de	295de	262de	186cd
C2 E1	700b	594bc	778b	674b	579ab
C2 E2	338d	351de	444cd	317d	316c
C3 E1	424cd	160f	205e	160e	148d
C3 E2	174e	189ef	302de	223de	178cd
C4 E1	747ab	692b	851ab	598bc	615ab
C4 E2	397cd	340de	307de	276de	151d
C5 E1	875a	921a	747b	882a	725a
C5 E2	407cd	297ef	369de	289de	285cd
C6 E1	760ab	936a	978a	728b	732a
C6 E2	497c	495cd	568c	460c	332c

Values followed by the same letter under each storage period are not significantly different ($p=0.05$).

Table 8: Interaction effect of cultivar and drying method (sun-drying-D1 and air-drying-D2) on germination index of *Capsicum annuum* seeds at 0 and 4 weeks of storage (WAS).

	Storage period (weeks)			
Cultivar X Drying	0	2	4	6
C×1 D1	529c	314fg	228f	260i
C×1 D2	596bc	724a	726b	614c
C×2 D1	314e	373efg	480def	401g
C×2 D2	724ab	571bcd	738b	590d
C×3 D1	239e	93h	127g	79j
C×3 D2	359de	256g	380ef	303h
C×4 D1	597bc	418d-g	478def	312h
C×4 D2	547c	615bd	679bc	562e
C×5 D1	583bc	519cde	545def	527f
C×5 D2	700ab	698ab	679bc	644b
C×6 D1	782a	794a	909a	669a
C×6 D2	475cd	475c-f	637bcd	518f

Values followed by the same letter under each storage period are not significantly different (p=0.05).

Table 9: **Interaction effect of extraction method (wet fruit-E1 and dry fruit-E2) and drying method (sun-drying-D1 and shade-drying-D2) on germination index of *Capsicum annuum* seed.**

	Storage period (week)		
Extraction X Drying	0	2	4
E1 D1	716a	621ab	696ab
E1 D2	709a	714a	746a
E2 D1	298b	217c	264c
E2 D2	425b	453b	497bc

Values followed by the same letter under each storage period are not significantly different (p=0.05).

Discussion

The moisture content range of 16-28% recorded from freshly extracted seeds falls below 40% reported by Hinje *et al.*, (2007) and also the range of 40-50% recorded by Christinal and Tholkkappian (2012) for some pepper varieties. Vidigal *et al.* (2011) also recorded a value of 47.3 % for sweet pepper seeds extracted from red fruits at 75 DAA while a range of 35-40% was recorded in pepper and tomatoes by Demir *et al.* (2002). The highest value of 27.8% moisture content in the current study is however, close to 31% reported by Chandy (1992). The variation among the different cultivars experimented upon in the current study and also when compared with the results of other researchers is not surprising as the trait has been reported to be affected by genotype and environment (Demir *et al.*, 2002; Vidigal *et al.*, 2011). The faster drying and lower seed moisture content recorded in sun-drying to air-drying in this study agrees with the trend reported by Hunje *et al.* (2007) due to higher temperature in the former than in the latter environment. Similar observation was reported by Samado *et al.* (2006) and Babiker *et al.* (2010) in respect of rice and sorghum, respectively.

Variation in the germination percentages of the different cultivars recorded in this study agrees with the report of Hinje *et al.* (2007) for different pepper varieties. Similar observations were recorded in pea (Smith *et al.*, 2006) and in spider plant morphotypes (K'Opondo and Francis,2011). Such variations have been attributed to differences in genetic makeup of the cultivars. Ali *et al.* (2012) stated that the viability levels of seeds of different genotypes may vary with seed moisture content and that seeds of different sorghum genotypes may have different critical moisture content below which seed quality will be impaired. It is possible that the moisture content of about 3.5% to which seeds of 'Tatashe' Dan-Kano was dried was below its critical level, hence the poor quality recorded. Engles and Engelmann (1998) also reported that critical moisture content may vary with species. Information seems to be non-existent on the specific extraction method that should preferably be adopted for pepper. Sukprakan *et al.* (2005) suggested that pepper seed may be extracted from fresh fruits or fruits that have been dried in the sun for a few days. The general practice in pepper seems to be that of sun-drying of fruits followed by seed extraction. Result from the current study however, agrees with the report by Savaraj *et al.* (2008) which showed that the wet extraction was beneficial to germination percentage and vigour of eggplant. Rahman *et al.* (2005) also advocated that seeds of eggplant be extracted by wet method and then shade-dried to ensure high quality. The poorer quality recorded in seeds extracted from sun-dried fruits maybe due to over-heating of seeds especially in all the cultivars except SB-DGU while the moisture content of the seed is high. High temperature and ultraviolet radiation through direct sunlight, together with high moisture content have been reported to be capable of accelerating respiration and impose stress to the seed, thereby bringing about ageing, thus adversely affecting the germinability; seeds may even be killed (Thomson and Stubsgaard 1998). Fast drying recorded in the sun may also have been responsible for poor seed quality in this study. Slow drying of eggplant seed was reported to have resulted in better seed quality by Zamariola *et al.* (2014). FAO (2014) also warned that over-drying of seed may reduce its quality. Contrary to this report, Hunje *et al.* (2007), Christinal and Tholkkappian (2012) recorded better seed quality when pepper fruits were dried in sun than those dried in the shade. The reason given was that slow-drying of seeds in the shade must have resulted in deterioration which manifested in poor germination and field emergence. This is, perhaps, what happened in SB-DGU in which seeds extracted from sun-dried fruits were of higher quality than those from shade-dried fruits. K'Opondo and Francis(2011) also observed that spiderplant seed dried under the sun had improved germination percentage, compared to drying under the shade. Contrary to the above trends, Muthoka (2003) reported that neither sun nor shade drying were detrimental to seed quality in *Milletia leucantha*.

Available results from this study indicated that not only did SB-DGU most often germinated higher it also germinated faster than most of the other cultivars. It was the opposite for TS-DKA. Kader (2005) argued that final germination percentage alone is not sufficient for reporting germination results. He, therefore, recommended the use of germination index (GI) as a comprehensive measurement parameter that combines both germination percentage and speed (spread, duration and 'high/low' events). Kader (2005) stated that the 'high' and 'low' germination events inbuilt into GI estimation are important indicators of seed vigour. Increases in germination percentages in some treatments after some period of storage is an indication of the presence of dormancy in the freshly extracted seeds which is known to exist in freshly harvested seeds of some crop species (Lee *et al.*, 2002). The decline in the values after attainment of maximum point suggests that deterioration sets in with progress in storage (Copeland *et al.*, 2001). It can therefore be concluded from this study that, except in cv. SB-DGU, it is not advisable to extract seed from sun-dried pepper fruits. Seeds should preferably be extracted from red-ripe freshly harvested fruits followed by air-drying.

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